

LANDFILL TECHNOLOGIES CORP.

**Workplan and Quality Assurance Project Plan for Hydrogeologic
Investigation and Groundwater Monitoring at the Arecibo's
Municipal Sanitary Landfill, Arecibo, Puerto Rico**

**September 2000
(Revised)**

Approval:

Quality Assurance Officer:

Date:

9/19/2000

Project Manager:

Date:

9/19/00

EQB Official:

Date:

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1.0 Introduction

This document presents a Workplan (WP) and Quality Assurance Project Plan (QAPP) for a hydrogeologic investigation and groundwater monitoring work at the Arecibo's Municipal Sanitary Landfill (AMSL) in Arecibo, Puerto Rico. The tasks described in this document are part of a first phase ("Detection Monitoring") investigation to be conducted at the above site following regulations and landfill monitoring requirements from the United States Environmental Protection Agency (USEPA) and the local Environmental Quality Board (EQB).

Topics such as project management, site background information, field investigation procedures, project schedules and deliverables, health and safety, and Quality Assurance / Quality Control (QA/QC) measures and procedures are included in this WP and QAPP.

This WP and QAPP has been prepared in accordance to the "RCRA Quality Assurance Project Plan Guidance" (NYS Department of Environmental Conservation, 1991), the EPA Solid Waste Disposal Facility Criteria Technical Manual and the document "Reglamentos para el Manejo de los Desperdicios Sólidos No Peligrosos" (November, 1997) from the EQB Office. All of the required elements for a QAPP applicable to this project are included in this document, including Rules 703-705 of the EQB document above ("P.I.S.M.A" and "P.M.A.").

Every investigation involving environmental field monitoring and laboratory measurements requires written WP and QAPP documents to ensure responsibility to the procedures to be implemented for each project. These present detailed procedures of the project to conduct the fieldwork and its objectives to the maximum extent practicable and in a cost-effective manner. Each individual or parties involved in generating data are grasped and documented. In essence, the objectives of the particular project are attained through the successful performance of the procedures designed and specifically detailed in the QAPP.

1.1 Project Description

The hydrogeologic investigation at the AMSL will consist of the assessment of the existing groundwater and geologic conditions at the site. Tasks include the determination of specific information on the uppermost aquifer, subsoil composition and structural geology and how these influence the local groundwater flow. Additionally, the study will analyze waste characteristics as well as climatic conditions and biological processes in order to evaluate their effects on contaminant fate and transport.

Essentially, the study involves field-testing and analysis of the soil/rock configuration and aquifer properties. The parameters to be analyzed include stratigraphy, porosity and degree of fracturing as well as estimates of hydraulic conductivity and gradient, aquifer thickness and the identification of groundwater recharge and discharge areas, among others.

Following the establishment of a conceptual model, the hydrogeologic investigation will aid in the design and installation of a groundwater monitoring system, which will yield groundwater samples from the uppermost aquifer for laboratory analyses. The chemical analyses of these samples will provide essential information on any impact caused by migration of contaminants from the landfill to the uppermost aquifer.

1.2 Background

The AMSL is located off Route 682 at the Ward Factor I, as shown in Figure 1 in Appendix I. The AMSL facility encompasses an area of approximately 99 acres, and is owned by the Puerto Rico Land Authority.

Adjacent to the north limit of the AMSL facility is mostly wetland areas and a channel, which is a natural reserve, known as "Caño Tiburones". Cow pastures border the remainder of the AMSL perimeter. The landfill entrance is located on the southern-western side of the facility and is accessed from Route 682.

According to operation records, the AMSL has been operating for more than thirty years. Atlantic Waste System and the Municipal Government previously operated the facility. More recently, Landfill Technologies of Arecibo Corp. has taken over the full operation of the facility.

The facility is currently operating and receives non-hazardous commercial waste and municipal solid waste from the municipalities of Arecibo, Manatí, Lares, Hatillo, Barceloneta and Utuado. Approximately 550 tons of waste is disposed off at the facility every day. In general, the facility handles common solid waste such as food, yard, organic, mixed paper, rubber and glass. Similar to most of the old landfills in Puerto Rico, the facility does not contain a basal liner system and its operation consists of a continuous deposition of alternated layers of waste and fill cover.

1.3 Project Objectives

The objective of the investigation is to assess the hydrogeologic setting of the landfill in order to design an effective groundwater-monitoring program. The groundwater monitoring is aimed to detect any contamination emanating from the landfill. The specific data gathered from both tasks will aid to determine the need for future corrective action.

2.0 Hydrogeologic Investigation and Groundwater Monitoring System Design

2.1 Approach

The characterization of the hydrogeology of the site and the development of the existing groundwater monitoring well network will be conducted following the techniques and procedures presented in the document "RCRA Ground-Water Monitoring: Draft Technical Guidance" (EPA/530-R-93-001). The study will commence with a preliminary investigation that will include the following:

- Review of historic literature, as well as geologic, hydrogeologic, geographic and, if available, field data from previous studies at the site.
- Gathering information that will be useful for planning a time and cost-effective field investigation.
- A general characterization of the chemical and physical properties of wastes.

The field investigations will comprise the subsurface characterization, the analyses of soil and rock samples, geologic mapping, hydrogeologic and aerial photo analysis, among others. The results obtained through the field investigations will provide sufficient information about the design of the groundwater monitoring wells, depths, diameter, elevations, etc. Five existing monitoring wells were installed at the facility aimed to intercept and monitor the potential pathways of contaminants in the subsurface. One of the existing wells will provide representative background groundwater samples (e.g., upgradient) while the remaining four will provide downgradient representative groundwater samples.

2.2 Monitoring System Layout

The site plan on Figure 2 in Appendix I show the location of five existing monitoring wells located at the facility. The final selected locations of the wells were highly dependent on a preliminary site reconnaissance and on the results of the subsurface drilling conditions and uppermost aquifer elevations. These preliminary locations were selected based on the lateral extent of the existing waste and the results of the preliminary geologic and hydrogeologic reconnaissance conducted at the site. These locations comprise one background well (MW-1) and four points of compliance wells (MW-2, MW-3, MW-4 and MW-5).

According to a site reconnaissance and well inspection report realized by Geologist Ernesto X. Balay (Lic no. 014-GP) on last March 27th 2000, (Refer to Appendix II), the AMSL well conditions are the following: wells were constructed with four (4) inch diameter PVC piping, well intake area consists of factory slotted screen, 15.0 feet in length and 0.020 slot size to compensate for seasonal variations of groundwater levels and obtain low turbidity (<5 nephelometric turbidity units) groundwater.

The following table presents a summary of the data obtained during field inspection:

WELL NUMBER	MATERIAL/ DIAMETER (IN)	DEPTH/ SLOT INTERVAL (FT)	ESTIMATED WATER TABLE (FT)	POTENTIOMETRIC DEPTH FROM TOP OF PVC (FT)	TOTAL DEPTH FROM SURFACE (FT)	DEPTH INCLUDING 2.5 FT OF TOP OF PVC (FT)
MW-1	PVC/4	13-28	18	3.10	33.0	35.0
MW-2	PVC/4	10-25	15	6.20	30.0	32.5
MW-3	PVC/4	32-47	37	9.85	52.0	52.5
MW-4	PVC/4	25-40	30	6.30	45.0	45.3
MW-5	PVC/4	22-37	27	3.50	42.0	40.0

From the data obtained it could be assumed that wells 1 and 2 have approximately from zero to half foot (0 @ ½ foot) of sediments; wells 3 and 4 could have between two to two and an half (2 @2.5 feet) of sediments, and well 5 approximately four to four and half feet (4 @ 4.5 feet) of sediments.

2.3 Field Standard Operating Procedures

The Standard Operating Procedures (Appendix IV) describe methods used for preventing or reducing cross-examination and collection of representative soil samples for delineating subsurface conditions. Additionally they provide guidelines and general reference information on well installation, development, aquifer testing and groundwater sampling.

These guidelines are primarily concerned with the collection of samples from the uppermost aquifer and are designed to be used in conjunction with the most common types of groundwater contaminants (e.g., volatile organic compounds and metals).

2.4 Schedule of Activities

The proposed schedule for coordination and preparation of field activities, as well as work, data review and report preparation is presented in Table 3-1 in Appendix III. Specific dates are considered tentative at this point. Actual starting date will depend on dates of approval of work plan document by the EQB Office.

3.0 Quality Assurance Project Plan (QAPP) for Groundwater Sampling

3.1 Project Description

The project work plan addressed in sections 1.0 and 2.0 above describes the tasks and their data quality objectives to conduct an evaluation of environmental and hydrogeologic conditions at the Site. The QAPP has been prepared for the collection of groundwater samples from an uppermost aquifer and their laboratory analysis. The field and sampling procedures are described in Section 2.0 and Appendix IV, Field SOP's.

The groundwater-sampling program will comprise two semi-annual (every six (6) months) sampling events in accordance with 40 CFR Part 258.54. The first event will consist of sampling a minimum of three (3) samples and one (1) independent sample from both background and point of compliance wells. The second event will also consist of sampling a minimum of three (3) samples and one (1) independent sample per well. However, this number may vary and is dependent on the results of the chemical analyses of the first monitoring event. One equipment blank, one field blank and one field duplicate from a randomly selected location will be analyzed for the parameters specified will be collected at a 1:20 samples ratio. The equipment blank will be collected from analyte-free water passed over the decontaminated equipment. Trip blanks will be analyzed at a 1:20 ratio or with each shipment, whichever is greater.

3.1.1 Laboratory Qualifications

The High Technology Laboratory from San Juan, Puerto Rico will conduct all analytical work required for this investigation. High Technology provides both inorganic and organic analytical services for environmental evaluations.

3.1.2 Analytical Methods and Reporting Limits

The "Detection Monitoring" phase, which makes up the objective of this investigation, will specifically target constituents presented in Tables 3-1A and 3-1B. These constituents are listed in Appendix I to Part 258 – Criteria for Municipal Solid Waste Landfills, Subpart E – Groundwater Monitoring and Corrective Action. The list contains 47 volatile organics and 15 metals for which method 8260 and methods 6010 or from the 7000

series methods are required, respectively. These methods will be revised and verified in order to have them updated.

The results obtained from the laboratory analyses will be compared and evaluated against background samples and maximum contaminant levels (MCL's) as presented in the Maximum Contaminant Levels (MCL's) as per RCRA Sampling Procedures Handbook, Appendix B, Drinking Water Regulations and Health Advisories USEPA, 1994 (Table 4-2)

3.1.3 Data Quality Objectives

The results obtained through the hydrogeologic investigation and groundwater sampling will be used to characterize groundwater movement at the site and to evaluate the presence of volatile organic compounds and metals.

Specific data collection objectives for each field task are described in the field SOP's in Appendix IV. These objectives will be evaluated on the three analytical levels described below:

- Level I. Includes field screening or measurements with organic vapor analyzers and water level indicators where not quantitative or not compound-specific results are generated. Only qualitative data is generated.
- Level II. Analyses conducted with sophisticated, portable instruments like pH and conductivity meters, which can generate a wide range of data quality.
- Level III. Includes analyses of groundwater monitoring well samples. A rigorous QA/QC deliverable documentation from the laboratory to be used in data validation procedures.

3.2 Project Organization and Responsibility

Landfill Technologies Corp. will implement all field tests for the evaluation and sampling procedures as described in Section 2.0. Ms. Zoe Atances, Engineer, M.B.A., will be in charge of the overall project coordination; sampling QA operations and data quality reviews. The qualified staff of High Technology Laboratory will conduct laboratory QC and analyses. The laboratory key individuals are listed in the laboratory's

Statement of Qualifications in Appendix V of this document. High Technology Laboratory will also provide data quality review, including data assessment and validation.

3.3 Quality Assurance Objectives for Data Measurement

The QA objectives for data measurement in both field and analytical procedures are to collect data of acceptable quality, using the PARCC (Precision, Accuracy, Representativeness, Completeness and Comparability) parameters.

3.3.1 Precision

The parameter measures the reproducibility of analyses under a given set of conditions. In other words, it provides a quantitative measure of how data from replicate duplicate samples differ. The precision will be compared to the requirements specified in the analytical methods.

The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV).

$$RSD = CV = 100 S/x, \text{ where}$$

S = variance and x = the arithmetic mean of the x measurements

Precision is also estimated from the relative percent difference (RPD) of the concentration measured from matrix spike/matrix spike duplicate pairs.

$$RPD = \frac{(C_1 - C_2)}{\frac{(C_1 + C_2)}{2}} \times 100$$

C₁ = measured concentration of the first sample aliquot

C₂ = measured concentration of the second sample aliquot

3.3.2 Accuracy

Accuracy is a measure of the degree of difference between a measured or reported data value and the "true" value. The closer they are, the more accurate the measurement is. In the laboratory it is assessed

through the analysis of quality control samples, specified in the analytical methods.

Accuracy is estimated from the recovery of spiked analyzed from the matrix of interest.

$$\text{Recovery} = \%R = \frac{C_s - C_u}{C_n} \times 100$$

Where: C_s = measured concentration of spiked sample aliquot
 C_u = measured concentration of the unspiked sample aliquot

C_n = nominal (theoretical) concentration increase that results from spiking the sample

3.3.3 Representativeness

The degree to which collected samples accurately represent the environmental conditions at the site is expressed as representativeness. It is addressed by describing the sample collection techniques, the number of samples and sampling locations. Also considered will be the appropriateness of the analytical methods to be used.

3.3.4 Completeness

This parameter is defined as the measure of the amount of valid data obtained from the measurement compared to the amount expected under normal conditions. The expected amount is the one required to meet the project objectives. The report will address whether the validated data meets the objectives.

3.3.5 Comparability

Comparability is defined as the degree of confidence with which independent data sets can be compared. For this investigation, comparability is assured by using standard sampling and analytical protocols as well as consistent reporting procedures.

3.4 Field Sampling Procedures

The sampling and decontamination procedures for this investigation are presented in Section 2.3 (Field SOP's). A summary of sample collection and preservation procedures is presented in Table 3-3 of this QAPP.

3.5 Documentation and Chain of Custody Procedures

Proper documentation of the preparation, handling, storage and shipping of collected samples from the field to the laboratory are provided by designing sample custody procedures. Chain-of-custody forms are to be completed by the field staff prior to sample shipment (Refer to Appendix V for a copy of a chain-of-custody form). Included in the form are the sample identification number, project number, location, date and time of collection, preservatives (if any), and the name of the sampler. A copy of the sample container label is presented in Appendix V.

The chain-of-custody record will also present the shipment contents, signatures with waterproof ink of the sampler, as well as from the individual relinquishing and receiving the shipment. The documents are placed inside the shipping container and are protected by a sealed plastic envelope. Internal laboratory custody procedures are conducted once the sample arrives at the laboratory.

The standard procedures for sample shipment will be to ship the containers within 24 hours from collection time to the laboratory through a next-day carrier. The samples will be properly packed for shipment according to the laboratory protocols. This involves placing the sample in a plastic bag and placing the bag in a plastic cooler with bagged ice for coolant. The cooler is then filled with shock and liquid absorbent material to avoid spillage or breakage of the sample containers.

The method of shipment, courier name and other information will be entered in the remark section of the custody reports. The coolers will be sealed with nylon strapping tape and chain-of-custody seals to allow the receiver to document any tampering that may have taken place during shipment.

3.6 Calibration Procedures

The field equipment to be used for the investigation will be calibrated each field day, in accordance to the manufacturer's specifications. Included are the water level indicators, PhD Lite Multi Gas Detector and the pH conductivity meters. Calibration procedures will be documented on data sheets during the field activities. Calibration procedures for the PhD Lite, pH and conductivity meters will be provided with the report. A copy of the Calibration Procedures for the equipment to be used is presented in Appendix VI. SOPs for water level measurements have been provided in this document.

3.7 Analytical Procedures

Field analyses will be conducted in accordance with the equipment manufacturer's instructions, where applicable. Analytical procedures for volatile organics will be performed by USEPA's SW-846, method 8260. The methods 6010 or methods from the 7000 series will analyze metals. Regulatory or standard procedures for sample preservation and analyses follow EPA methods specified in 40CFR part 136, (Federal Register 43234, 26 Oct. 84).

3.8 Data Reduction, Validation and Reporting

Landfill Technologies Corp and High Technology Laboratory will conduct reduction of the data collected during this investigation. High Technology Laboratory will perform validation and reporting of the analytical data.

3.8.1 Reduction

This procedure is based on summarizing the field data into a format to ease the analysis and interpretation. The type of reduction, reporting units, equations used, methods and corrections for field instruments will be conducted in the report.

3.8.2 Validation and Reporting

High Technology Laboratory will conduct validation and reporting of 100 percent of the analytical data generated from the specified methods. Any additional data not covered by the SOPs or guidelines will be reviewed qualitatively by Landfill Technologies Corp. to assess if QA protocols were properly conducted. Data reporting will consist of presentation of analytical data and blank and quality control (QC) samples in tubular forms that include the sampler number, matrix, parameter and reporting limits.

The report will include all field data collected in logs or logbook with entries signed and dated, chain-of-custody records and sample analyses request forms. QC documentation for the analytical data will also be presented along with results from duplicates, blanks, matrix spikes and blank spikes. Additionally, the report will present method detection limits, instrument detection limits, data validation procedure results and checklists. A qualified professional, either a PR-licensed Chemist or Chemical Engineer or related environmental professional will perform independent data validation. The name and qualifications of this consultant will be provided with the results and evaluations of the sampling results.

The independent validation will be based on the criteria that would include (1) holding times, (2) instrument tuning and (3) calibration blanks.

All sample data and its QA/QC will be maintained accessible to the EQB on request.

3.9 Internal Quality Control Checks

Quality Control checks performed by Landfill Technologies Corp. will consist of generating QC samples including equipment blanks; field replicated and trips blanks. All blanks will be collected as specified in the SOPs in Appendix IV and will be analyzed for the same parameters as the samples. The Statement of Qualifications in Appendix V provided by High Technology Laboratory describes the types of control samples required, control frequency and QC acceptance criteria.

3.10 Performance and System Audits

Field performance audits will be conducted during the investigation as data is generated and reduced. These will result from the proper documentation of numerical manipulations and manual calculations performed at the site. Also, the results from the field and equipment blanks will act as an indirect audit of the sampling integrity.

3.11 Preventive Maintenance

Preventive Maintenance of field equipment will be conducted according to the manufacturer's specifications. Laboratory preventive maintenance will be as specified in the laboratory's statement of Qualifications in Appendix V.

3.12 Data Assessment Procedures

The procedures utilized to assess parameters for the precision accuracy and completeness of the data will be conducted as specified in Section 3.4 and on the laboratory's Statement of Qualifications in the Appendix V of this QAPP. The parametric analysis of variance (ANOVA) will be applied as a statistical analysis as per 40CFR 258.53. The ANOVA tests for a difference in means. It will be followed by multiple comparison procedures to identify statistically significant evidence of contamination and will include estimation and testing of contrast between compliance well means and background mean levels for each constituent.

3.13 Corrective Actions

If unacceptable data or conditions are encountered during the control audits, the Project Manager or Officer will be notified to conduct a corrective action by any of the following:

- Resampling and reanalyzing if holding time criteria permits
- Amend analytical procedures

The laboratory will determine if any corrective action should be performed on suspected unreliable data.

3.14 Quality Assurance Reports

Quality Assurance/Quality Control reports generated by High Technology Laboratory will be used to describe the quality of the data. Landfill technologies Corp. will receive the same reports.

References

Environmental Quality Board, 1997. "Reglamento para el Manejo de los Desperdicios Sólidos No Peligrosos".

Hydrogeologic Map of Puerto Rico and Adjacent Islands, 1965. By R.P. Briggs and J.P. Akers.

NYS Department of Environmental Conservation, 1991. RCRA Quality Assurance Project Plan Guidance.

RCRA Sampling Procedures Handbook, Appendix B. Drinking Water Regulations and Health Advisories USEPA, 1994.

USEPA, 1993. Solid Waste Disposal Facility Criteria. Technical Manual. EPA 530-R-93-017.

USGS Atlas of Groundwater Resources in P.R., 1996. T.D. Veve and B.E. Taggart.

USGS 7.5-Minute Arecibo Topographic Quadrangle, 1969. Photo revised in 1982.

Appendix I. Figures

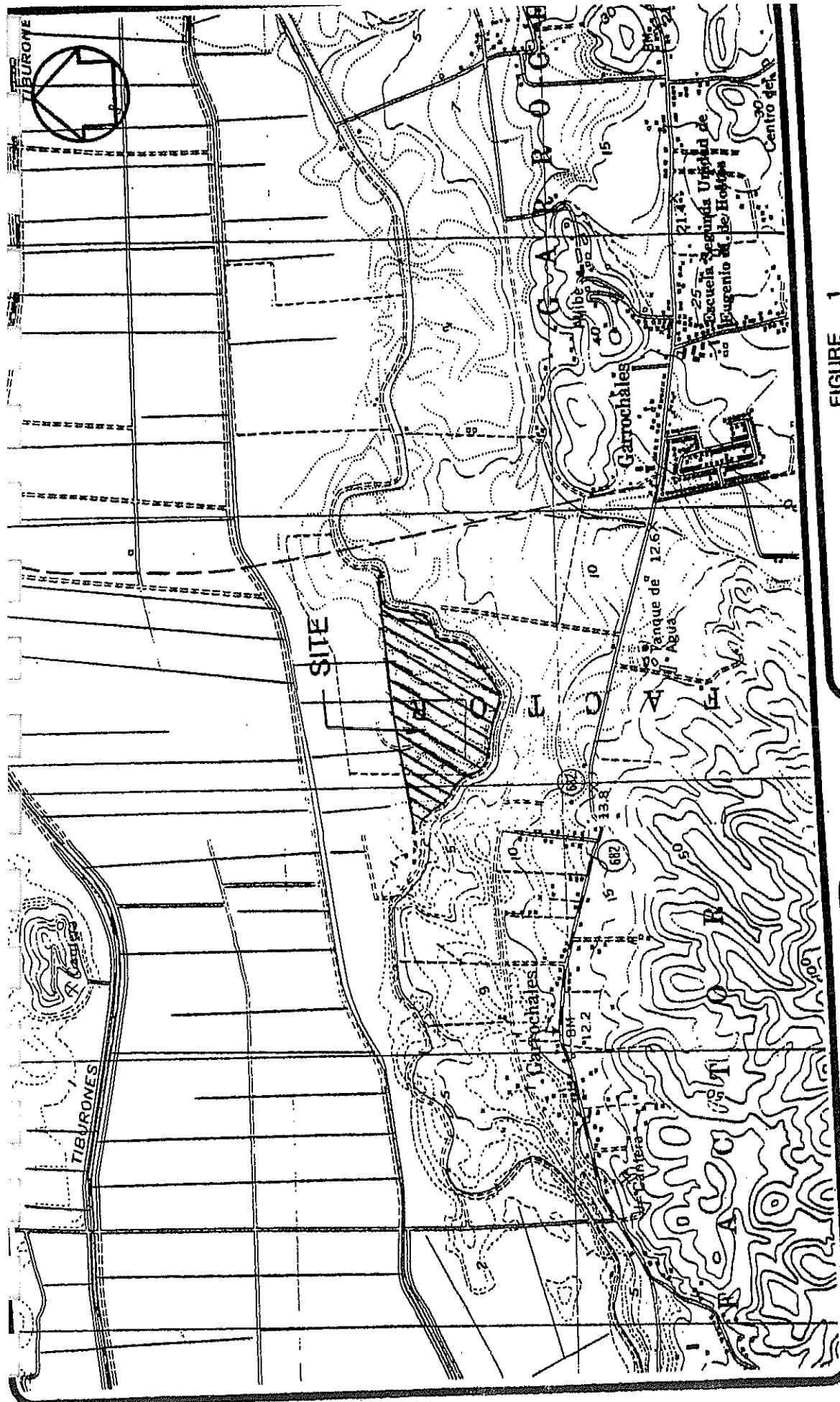


FIGURE 1
ARECIBO REGIONAL LANDFILL
SITE LOCATION PLAN

Appendix II. Geologist's Technical Evaluation

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Box 11
Hormigueros PR, 00660
(787) 855 - 4307

6 de abril de 2000

Ing. Zoe Atances González
Landfill Technologies
Box 13487, San Juan PR 00908

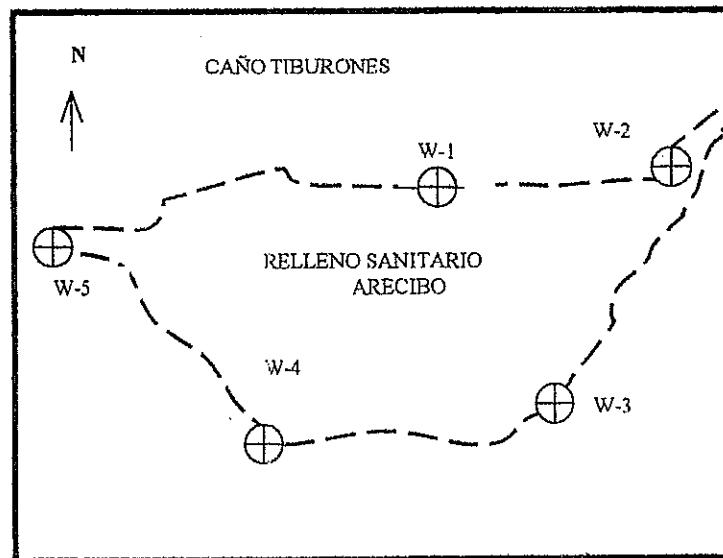
EVALUACIÓN TÉCNICA DE LOS
POZOS DE MONITORÍA DE AGUAS SUBTERRÁNEAS
RELLENO SANITARIO DE ARECIBO

Estimada Ing. Atances:

Durante la visita realizada el pasado 27 de marzo de 2000 a las facilidades del relleno sanitario de Arecibo inspeccioné los pozos de monitoría de aguas subterráneas para verificar la condición de los mismos. A continuación se resume las condiciones de los mismos y se expone la información general de la construcción de los pozos obtenida en conversación con personal de la firma Geocim, la cual instaló los pozos. Las especificaciones obtenidas no están certificadas, sin embargo se presentan a continuación a manera de referencia. Según la información obtenida la compañía que subcontrató a Geocim fue la compañía norteamericana SBE Environmental. En general, las especificaciones para la construcción de los pozos requerían de la construcción de pozos hechos en tubería PVC de cuatro pulgadas de diámetro, con un intervalo ranurado de quince pies comenzando a cinco pies sobre el nivel de la tabla de agua. Basado en estas especificaciones se estimó la profundidad a la que fue encontrada la tabla de agua durante el barrenado.

A continuación se presenta un desglose de la información recopilada en la inspección y en las especificaciones obtenidas para los pozos de monitoría.

NUMERO DE POZO	MATERIAL/ DIAMETRO (IN)	PROFUNDIDAD INTERVALO RANURADO (FT)	PROFUNDIDAD ESTIMADA DE LA TABLA DE AGUA (FT)	PROFUNDIDAD NIVEL POTENCIOMETRICO ACTUAL (FT) DESDE EL TOPE DE LA CAMISILLA DE PVC	PROFUNDIDAD TOTAL (FT) (GEOCIM) DESDE LA SUPERFICIE DEL TERRENO	PROFUNDIDAD ACTUAL (FT) INCLUYENDO 2.5 FT DE PVC SOBRE EL TERRENO
W-1	PVC/ 4	13 - 28	18	3.10	33.0	35.0
W-2	PVC/ 4	10 - 25	15	6.20	30.0	32.5
W-3	PVC/ 4	32 - 47	37	9.85	52.0	52.5
W-4	PVC/ 4	25 - 40	30	6.30	45.0	45.3
W-5	PVC/ 4	22 - 37	27	3.50	42.0	40.0



Esquema del relleno sanitario de Arecibo localizado en el Caño Tiburones. En el mismo se indica la localización aproximada de los pozos de monitoría de aguas subterráneas.

De esta información se desprende que los pozos W-1 y 2 pudieran tener un aproximado de cero a medio pie de sedimento (0 - 0.5 ft); los pozos W-3 y 4 pueden tener entre dos a dos y medio pies de sedimento (2 – 2.5 ft) y el pozo W-5 pudiera tener cerca de cuatro pies y medio de sedimento (4.5 ft).

Los datos de profundidad de aguas subterráneas sugieren que las mismas provienen de un acuífero semi-confinado. Dado a que la información de los pozos obtenida no incluye información sobre la litología del área, se puede inferir dada la geología de la región que el acuífero superior en esta región se localiza en los llamados “blanket deposits”, los cuales generalmente están compuestos por cienos y arcillas arenosas de cuarzo. En general la geología en el área del relleno sanitario de Arecibo podría estar compuesta por una primera formación geológica de depósitos de orgánicos de humedal de aproximadamente diez pies de espesor, seguida por una unidad de arenas arcillosas con un espesor de treinta a cuarenta pies y finalmente se comenzarían a encontrar formaciones calizas del terciario.

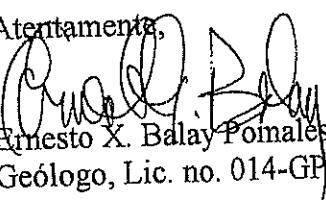
Basados en la información antes expuesta se concluye que los pozos tienen una cantidad de sedimento aceptable para poder ser utilizados para actividades de muestreo. Sin embargo, antes realizar las actividades de muestreo se recomienda que se limpian las bases de los pozos para confirmar la condición del sello superior de la cubierta de los pozos, también se recomienda que se reparen las tapas de metal de los mismos y que se desarrolle los pozos antes de la purga de muestreo. Además se recomienda que se realicen dos barrenos exploratorios para poder describir adecuadamente la geología del lugar. Esto es necesario para poder evaluar el sistema de monitoría existente. Los barrenos deberán estar ubicados al norte y al sur de la facilidad.

6/4/2000
Landfill Technologies
Relleno Sanitario Arecibo

Otro asunto discutido durante la visita de inspección fue el de la localización de los pozos de monitoría de gases. Hay que señalar que para que estos pozos sea efectivos hay que localizar los mismos en áreas donde no entren en contacto con las aguas subterráneas. Además se recomienda que se localicen los mismos cerca de áreas donde hay personal como oficinas y talleres. Cabe señalar que a estos pozos se le pueden añadir extensiones para así poder seguir utilizándolos a medida que aumentan las elevaciones del terreno.

De tener alguna pregunta o comentario al respecto favor de comunicarse conmigo al teléfono 855-4307.

Atenadamente,


Ernesto X. Balay Pomales, MS, PG
Geólogo, Lic. no. 014-GP

Appendix III. Tables

Table 3-1A. Constituents and Quantitation Limits for Detection Monitoring
as per Appendix I to Part 258, 40CFR.

Volatile Organic Compound Report

8260 in Water

Client Sample ID

Sample Tag No.:
Lab Sample ID:
Matrix: Water
Date Filename:

EPA Method: 8260
Date Sampled:
Date Analyzed:
Analyst: RSW
Units:
Dilution Factor: 1

ANALYTE	CAS NUMBER	CONCENTRATION	QUANTITATION LIMITS	QUALIFIER
Dichlorodifluoromethane	75-71-8		10	U
Chloromethane	74-87-3		10	U
Vinyl Chloride	75-01-4		2	U
Bromomethane	74-97-5		10	U
Chloroethane	75-00-3		10	U
Trichlorofluoromethane	75-69-4		10	U
1,1-Dichloroethene	75-35-4		5	U
Methylene Chloride	75-09-2		5	U
trans-1,2-Dichloroethene	156-60-5		5	U
1,1-Dichloroethene	75-34-3		5	U
cis-1,2-Dichloroethene	156-59-2		5	U
2,2-Dicloropropane	594-20-7		5	U
Bromoform	74-97-5		5	U
Chloroform	67-66-3		5	U
1,1,1-Trichloroethane	71-55-6		5	U
1,1-Dichloropropene	563-58-6		5	U
Carbon Tetrachloride	56-23-5		5	U
1,2 Dichloroethane	107-06-2		0.4	U
Benzene	71-43-2		5	U
Trichloroethene	79-01-6		5	U
1,2-Dichloropropane	78-87-5		5	U
Dibromomethane	74-95-3		5	U
Bromodichloromethane	75-27-4		5	U
trans-1,3-Dichloropropene	10061-02-6		5	U
Toluene	108-88-3		5	U
Cis-1,3-Dichloropropene	10061-01-5		5	U
1,1,2-Trichloroethane	79-00-5		5	U
1,2-Dibromoethane	106-93-4		5	U
1,3-Dichloropropane	142-28-9		5	U
Tetrachloroethene	127-18-4		5	U
Dibromochloromethane	124-48-1		5	U
Chlorobenzene	108-90-7		5	U
1,1,1,2-Tetracholoroethane	630-20-6		5	U
Ethylbenzene	100-41-4		5	U
M & p-Xylenes			5	U

Table 3-1A Cont., Constituents and Quantitation Limits for Detection Monitoring as per Appendix I to Part 258, 40CFR.

ANALYTE	CAS NUMBER	CONCENTRATION	QUANTITATION LIMITS	QUALIFIER
o-Xylene	106-42-3		5	U
Styrene	100-42-5		5	U
Bromoform	75-25-2		5	U
Isopropylbenzene	98-82-8		5	U
1,1,2,2-Tetrachloroethane	79-34-5		5	U
Bromobenzene	108-86-1		5	U
1,2,3-Trichloropropane	96-18-4		5	U
n-Propylbenzene	103-65-1		5	U
2-Chlorotoluene	95-49-8		5	U
1,3,5-Trimethylbenzene	108-67-8		5	U
4-Chlorotoluene	106-43-4		5	U
t-Butylbenzene	98-06-6		5	U
1,2,4-Trimethylbenzene	95-63-6		5	U
s-Butylbenzene	135-98-8		5	U
1,3-Dichlorobenzene	541-73-1		5	U
p-Isopropyltoluene	99-87-6		5	U
1,4-Dichlorobenzene	106-46-7		5	U
n-Butylbenzene	104-51-8		5	U
1,2-Dichlorobenzene	95-50-1		5	U
1,2-Dibromo-3-chloropropane	96-12-8		5	U
1,2,4-Trichlorobenzene	120-82-1		5	U
Hexacholorobutadiene	87-68-3		5	U
Naphthalene	91-20-3		10	U
1,2,3-Tricholorobenzene	87-61-6		5	U

SURROGATE COMPOUND	%REC	RECOVERY LIMITS (%)
(SS) Dibromofluoromethane	100 %	86 --- 118
(SS) Toluene-d8	100 %	88 --- 110
(SS) p-Bromofluorobenzene	100 %	86 --- 116

Qualifiers:

- "U" – Indicates compound was search for and not detected.
- "B" – Indicates compound was found in the method blank.
- "J" – Indicates compound was identified out of the method working limits and should be considered an estimated value.
- "D" – Indicates compound was run at a dilution.
- ** – Indicates surrogate recovery is not within method limits due to matrix effect.

Note: Method detection limits are approximately 1/5 of reporting limits.

Table 3-1. Proposed schedule of activities for hydrogeologic investigation and groundwater monitoring.

ACTIVITY	DATE	DAILY TIME PERIOD
-EQB Approval	May – June 2000	--
-Staff and crew coordination	June 2000	--
-Laboratory procurement	June 2000	--
-Monitoring wells (5) development	June 2000	7:00-4:00
-Well purging, groundwater sampling and sample shipment	June 2000	7:00-4:00
-Laboratory analysis	June 2000	--
-Data Review	June 2000	8:00-5:00
-Draft / Final Report	June 2000	8:00-5:00
-Second Sampling Event	December 2000	7:00-4:00
-Results with Report	December 2000	7:00-4:00

Table 3-1B. Constituents and Quantitation Limits for Detection Monitoring as per Appendix I to Part 258, 40CFR.

TABLE I
ATOMIC ABSORPTION CONCENTRATION RANGES

Metal	DIRECT ASPIRATION		Furnace Procedure ^{a,c} Detection Limit (ug/L)
	Detection Limit (mg/L)	Sensitivity (mg/L)	
Aluminum	0.1	1	--
Antimony	0.2	0.5	3
Arsenic ^b	0.002	--	1
Barium	0.1	0.4	2
Beryllium	0.005	0.025	0.2
Cadmium	0.005	0.025	0.1
Calcium	0.01	0.08	--
Chromium	0.05	0.25	1
Cobalt	0.05	0.2	1
Copper	0.02	0.1	1
Iron	0.03	0.12	1
Lead	0.1	0.5	1
Lithium	0.002	0.04	--
Magnesium	0.001	0.007	--
Manganese	0.01	0.05	0.2
Mercury ^d	0.0002	--	--
Molybdenum (p)	0.1	0.4	1
Nickel	0.04	0.15	--
Osmium	0.03	1	--
Potassium	0.01	0.04	--
Selenium ^b	0.002	--	2
Silver	0.01	0.06	0.2
Sodium	0.002	0.015	--
Strontium	0.03	0.15	--
Thallium	0.1	0.5	1
Tin	0.8	4	--
Vanadium (p)	0.2	0.8	4
Zinc	0.005	0.02	0.05

NOTE: The symbol (p) indicates the use of pyrolytic graphite with the furnace procedure.

^a For furnace sensitivity values, consult instrument operating manual.

^b Gaseous hydride method.

^c The listed furnace values are those expected when using a 20- μ L injection and normal gas flow, except in the cases of arsenic and selenium, where gas interrupted is used.

^d Color vapor technique.

Table 3-2. Maximum Contaminant Levels (MCL's) as per RCRA Sampling Procedures Handbook. Appendix B. Drinking Water Regulations and Health Advisories USEPA, 1994.

VOLATILE ORGANICS	
CONSTITUENTS	MCL's (mg/l)
Dichlorodifluoromethane	--
Chloromethane	--
Vinyl Chloride	0.002
Bromemethane	--
Chloroethane	--
Trichlorofluoromethane	--
1,1-Dichloroethene	0.007
Methylene Chloride	--
trans-1,2-Dichloroethene	0.1
1,1-Dichloroethene	--
cis-1,2-Dichloroethene	0.07
2,2-Dicloropropane	--
Bromochloromethane	--
Chloroform	0.08
1,1,1-Trichloroethane	0.2
1,1-Dichloropropene	--
Carbon Tetrachloride	0.005
1,2 Dichloroethane	0.005
Benzene	0.005
Tricholoethene	0.005
1,2-Dichloropropane	0.005
Dibromomethane	--
Bromodichloromethane	0.08
trans-1,3-Dichloropropene	--
Toluene	1.0
Cis-1,3-Dichloropropene	--
1,1,2-Trichloroethane	0.005
1,2-Dibromoethane	--
1,3-Dichloropropane	--
Tetrachloroethene	0.05
Dibromochloromethane	--
Chlorobenzene	--
1,1,1,2-Tetracholoroethane	--
Ethylbenzene	0.7
M & p-Xylenes	10

Table 3-2. Cont., Maximum Contaminant Levels (MCL's) as per RCRA Sampling Procedures Handbook. Appendix B. Drinking Water Regulations and Health Advisories USEPA, 1994.

VOLATILE ORGANICS	
CONSTITUENTS	MCL's (mg/l)
o-Xylene	--
Styrene	0.1
Bromoform	0.08
Isopropylbenzene	--
1,1,2,2-Tetrachloroethane	--
Bromobenzene	--
1,2,3-Trichloropropane	--
n-Propylbenzene	--
2-Chlorotoluene	--
1,3,5-Trimethylbenzene	--
4-Chlorotoluene	--
t-Butylbenzene	--
1,2,4-Trimethylbenzene	--
s-Butylbenzene	--
1,3-Dichlorobenzene	--
p-Isopropyltoluene	--
1,4-Dichlorobenzene	--
n-Butylbenzene	--
1,2-Dichlorobenzene	--
1,2-Dibromo-3-chloropropane	--
1,2,4-Trichlorobenzene	0.07
Hexacholorobutadiene	--
Naphthalene	--
1,2,3-Tricholorobenzene	--

INORGANICS	
CONSTITUENTS	MCL's (mg/l)
Arsenic	0.05
Cadmium	0.005
Chromium	0.1
Barium	2.0
Lead	0.015
Mercury	0.002
Selenium	0.05
Silver	--
Nickel	0.1
Thallium	0.002
Vanadium	--
Zinc	--
Cobalt	--
Copper	1.3
Beryllium	0.004
Antimony	0.006

Table 3-3. Parameters, Sample Volumes, Containers, Preservatives and Holding Times.

PARAMETERS	MATRIX	SAMPLE QUANTITY/VOL.	CONTAINER TYPE	PRESERVATION	HOLDING TIME
Volatile Organic Compounds (VOC's)	Water	16 /40 ml	Glass with Teflon-lined septum caps	4 drops of HCL top pH<2, cool 4°C	7 days unpreserved, 14 days preserved
Metals	Water	16 /500 ml	Amber glass	Nitric Acid (HNO ₃) to pH<2	180 days except Chromium VI / 28 days for Mercury

Appendix IV. SOP's

**Landfill Technologies Corp.
Standard Operation Procedures**

**SOP # MA-001
Drilling and Sampling Equipment Decontamination**

Prepared by: Eng. Zoe Atances González, MBA

Effective Date: 9/19/2000

1.0 Scope and Application

The methods described in this SOP are aimed to prevent and reduce cross-contamination of samples, transfer of contaminants to clean areas, and to protect the health of site personnel. Most important, this SOP prevents introduction of error into the monitoring results.

2.0 Method Summary

The decontamination process will consist of washing and rinsing all the equipment that comes in contact with formation material or groundwater that is known or suspected of being contaminated. The methods to be employed are a quality-control measure required during drilling, monitoring well installation and groundwater sampling. A wash/rinse process will be applied to non-dedicated sampling tools, like split-spoons and bailers. These tools and the rest of the equipment will be washed with high-pressure water and stream rinsed between sampling intervals and boring locations.

3.0 Interference and Potential Problems

Tap water will be used for decontamination of sampling equipment, provided this one comes from a municipal water treatment system. Monitoring and sampling equipment must be carefully covered and protected with plastic liners to minimize contamination.

4.0 Equipment

- Appropriate personnel protective clothing
- Brushes, sponges
- Plastic sheeting
- Non-phosphate detergent
- Tap water

- Distilled water
- Container for disposal of wash water
- Safety glasses
- Steam cleaner
- Gloves

5.0 Procedures

The equipment decontamination plan will consist of one decontamination station located near the maintenance building. At this station, where electric power and tap water are available, a properly floored decontamination area will be designed with a sump pit or wash water collection facility. The collected wash water will be stored temporarily in plastic or metal containers until removed from the site for proper disposal.

All non-dedicated drilling and sampling equipment, including auger flights, drill rods, split-spoon, and hand tools and drilling rig, will be decontaminated after each boring/well location and after each sampling event with a pressurized steam-cleaner.

The split-spoon samplers and bailers will be hand-washed with a non-phosphate detergent and rinsed with distilled water. Wash water will be collected and disposed of as described above. Equipment will be covered with plastic sheeting and transported to the boring location on a pick-up truck to conduct drilling and sampling.

When sampling for metals the equipment will be washed with a 10% of HNO₃, and acetone or methanol will be used when sampling for VOC's. The equipment will be decontaminated as follows:

- Rinse with tap water and non-phosphate detergent
- Rinse with tap water
- Rinse with 10% of HNO₃ (for metals)
- Rinse with tap water
- Rinse with methanol
- Rinse with acetone*
- Rinse with methanol*
- Rinse with distilled water
- Dry

Note: These three steps are omitted for analyzing metals.

6.0 Quality Assurance/Quality Control

Two rinsate blanks will be collected from the sampling equipment to gather information on the effectiveness of the decontamination procedures. Each will consist of a sample of deionized (distilled) water passed over decontaminated equipment and placed in a clean sample container. These will be run for all parameters of interest at a rate of 1 per 20 for each parameter.

7.0 Health and Safety

The decontamination process will be performed under a Level D of protection. No potentially hazardous materials will be used at the site.

We will use the recommended equipment:

- Coveralls
- Safety boots/shoes
- Gloves
- Hard hats
- Safety glasses

**Landfill Technologies Corp.
Standard Operation Procedures**

**SOP # MA-002
Water Level Measurements**

Prepared by: Eng. Zoe Atances González, MBA

Effective Date: 3/1/2000

1.0 Scope and Application

This SOP provides guidelines for the determination of the depth to water in a cased borehole or monitoring well. These levels are used for constructing water table or potentiometric surface maps.

2.0 Method Summary

Ground water levels will be measured from a reference point marked at the top of the well casing. This point will be documented on the site logbook for future reference. Several measurements will be obtained prior to and after well construction and development, to obtain an average. All measuring equipment must be decontaminated between wells.

3.0 Interference and Potential Problems

False readings from the probes may be obtained if oil is present in ground water. Correct water level should be obtained after determining oil layer thickness. Turbulence in the well or cascading water may also difficult readings.

4.0 Equipment

- Electronic water indicator
- Alconox
- Tap water/deionized water
- Ruler
- Notebook
- Well data forms

5.0 Procedures

For preparation, the extent of the measurements as well as the amount of the equipment and supplies needed is to be determined. All the equipment must be pre-tested and decontaminated prior to its use. Also, a schedule should be prepared, including marking the exact measurement points on wells.

The next steps must be followed for the ground water levels measuring procedures:

- Hand wash equipment with an Alconox solution, followed by a triple deionized water rinse.
- Place the equipment on a clean surface.
- Remove locking well cap; note well number, time and date on the well data form.
- Lower the electric level indicator and conduct measurement from the reference point.
- Measure the total depth of well.
- Remove the equipment and replace cap and locks.
- Decontaminate the equipment.

6.0 Calculations

The following calculations should be conducted to determine the elevation of ground water above sea level.

Using this equation:

$$E_{gw} = E_s - D_{gw}$$

Where E_{gw} is the elevation above the sea level, E_s is the elevation of the land surface and D_{gw} is the recorded depth of ground water at the well.

7.0 Quality Assurance/Quality Control

The following quality assurance procedures comprise documentation of all data and activities, operation of instruments according to manufacturer's specifications and multiple measurement and testing to confirm all results

8.0 Health and Safety

Refer to the health and safety procedures followed in SOP # MA-001.

**Landfill Technologies Corp.
Standard Operation Procedures**

**SOP # MA-006
Soil and Rock Sampling**

Prepared by: Eng. Zoe Atances González, MBA

Effective Date: 3/1/2000

1.0 Scope and Application

This SOP describes the procedures for the collection and description of representative soil and rock samples. The analysis of these samples will provide valuable information on the geologic and hydrogeologic characteristics as well as on the hydraulic parameters existing at the site.

The procedures, proper documentation of activities, as well as recommendations for personal safety are included in the following sections.

2.0 Method Summary

Subsurface soil samples will be collected with the use of a split-spoon, 180 inch or a 24.0 inch sampler at suspected changes in lithology by means of the hollow stem auger method of drilling. The borings will be drilled to a depth of about 10.0 feet below the detected water table elevation. If needed, 5.0 feet rock cores will be collected if bedrock is encountered by using a water-cooled diamond bit coring system. All sampling devices will be cleaned and handled using the decontamination procedures in SOP #,

3.0 Sample Preservation, Containers and Storage

Preservation requirements are not applicable to this SOP. Samples will be removed after a visual inspection and screening for volatile organics and placed in plastic bottles for further laboratory analyses.

4.0 Equipment

- Sampling Plan
- Boring Location Plan
- Safety Equipment
- Compass
- Tape Measure
- Survey Stakes
- Camera

- Decontamination Equipment
- Drilling and Sampling Equipment
 - auger flights
 - drill rods
 - split-spoon samplers
 - plastic bottles
- Boring Log Forms
- Site Descriptions Forms

5.0 Procedures

Design a sampling plan in accordance with the Work Plan preparation and proposed schedule of activities. Review all background information of the site to reach sampling effort (like depth to water tables, presence of rock, etc.)

Identify local suppliers of sampling expendables and other equipment in case they are needed. Decontaminate all the equipment according to SOP #. Scrutinize the facility to pin point underground structures or utilities. Identify sampling location based in access, property boundaries and project objectives.

The procedure for sampling at depth with a split-spoon sampler consists of the extraction of a soil core of 18 to 24 inches in length with the use of a stainless steel barrel sampler, through a hollow stem auger flight. The work will be performed following ASTM-D-1586-84 requirements of the Standard Penetration Test and Soil Sampling. Sampling procedures consist of assembling the sampler and placing it in a perpendicular position at the bottom of the borehole or surface of the sample material. The sampler is then driven hydraulically or by the continuos fall of a 140 pound weight hammer to the desired depth, usually the length of the sampler. The length or number of hammer blows is then recorded to obtain depth of penetration and/or information on density of the soils.

The sampler is then withdrawn and opened and its contents examined and cut in half with a stainless steel knife in a longitudinal way. The following descriptions and analyses are to be performed following ASTM-586-67. Sample is placed in a plastic bottle and later transported to the laboratory for further analysis. Post operations activities include decontamination of equipment and logging data to appropriate forms.

6.0 Health and Safety

Coordination and previous training will be required prior to conducting the work. Physical hazards to be avoided include injuries associated with moving equipment, heat stress as a result of extreme temperatures and slip/fall conditions due to site obstructions.

**Landfill Technologies Corp.
Standard Operation Procedures**

**SOP # MA-008
Well Development**

Prepared by: Eng. Zoe Atances González, MBA

Effective Date: 3/1/2000

1.0 Scope and Application

The main objective of monitoring well development is to remove all the fine particles around the well screen, like clay and slit. This will allow a non-interrupted flow of ground water from the formation to the well and vice-versa. A combination of surging and bailing is one of the most common methods of well development.

2.0 Method Summary

The well development method to be used is known as surging and consists of repeatedly raising and lowering a surge block or surge planner into the well. The resulting motion loosens the fine sediment while it surges water into the formation. The loose sediment must be removed, usually with a bailer, from the well to prevent sand locking of the block and resettlement of fines.

The process is continued until water retrieved is clear and free of sediment and until groundwater parameters, such as temperatures, pH and specific conductance has stabilized.

3.0 Interference and Potential Problems

During well development by the surging method, there is a possibility of disturbing the filter pack. For that reason, the surging should be conducted at a slow rate to avoid the generation of channels or voids near the screen.

4.0 Equipment

- Water level indicator
- Surge block
- Teflon cable
- Bailer, submersible pump or hand pump
- Portable water tester for temperature, pH and conductivity
- Well development forms
- Plastic liner

- OVA
- Five-gallon bucket
- Gloves

5.0 Procedures

For preparation, obtain information and access to site, as well as keys to unlock covers and caps. Bring "as built" logs of monitoring wells and additional information on existing contaminants. Obtain all the instruments described in the previous sections, as well as containers for disposal of the extracted water.

At least 3 to 5 times the volume of groundwater in the well should be removed to achieve a good development. Well development should be conducted soon after installation, but not before 48 hours, to allow grout setting.

The next steps will be followed for the well development procedures:

1. Assemble and pre-test all instrumentation and place it on a plastic sheet close to the well.
2. Record all information on the well development forms (date, time, well number, etc.)
3. Open cap and take air monitoring readings of the OVA.
4. Measure the groundwater level and the total depth of well.
5. Surge and bail until water is clear and readings of parameters have stabilized.
6. Record water level before and after development, volume of water removed, instruments used and final readings of parameters.
7. Decontaminate all equipment following procedures as from SOP # ...

6.0 Calculations

The well development process can be achieved without calculations unless it is necessary to calculate the volume of water in the well with the following formula:

$$V_w \text{ (Volume of Well)} = \pi r^2 h(\text{cf})$$

Since the volume of water per lineal foot in a 2-inch well is 0.1632 gal/ft the equation becomes:

$$V_w = h(v) \text{ where, } h=\text{height of water column (ft)} \text{ and } v=0.1632 \text{ gal/ft}$$

7.0 Quality Assurance / Quality Control

All pertinent data regarding the well development procedures above must be documented on data sheets or field logbooks. All instruments must be calibrated and used according to the manufacturer's specifications.

8.0 Health and Safety

Refer to the Health and Safety procedures described SOP #...

**Landfill Technologies Corp.
Standard Operation Procedures**

**SOP # MA-009
Ground Water Sampling**

Prepared by: Eng. Zoe Atances González, MBA

Effective Date: 3/1/2000

1.0 Scope and Application

This Standard Operating Procedure provides general information on ground sampling from the uppermost aquifer of a particular site. Every aspect of the process is aimed to ensure that the sample is representative of the particular zone of groundwater being sampled.

2.0 Summary

Groundwater sampling can not be conducted without properly purging the monitoring wells. Purging is the process of removing the stagnant water from the well to obtain a representative groundwater sample from the aquifer. Purging can be conducted with bailers or submersible pumps and shall consist of removing a minimum of three well volumes. Once purging is completed, sampling can be conducted with the same instruments. Proper decontamination of equipment and sample containers is required for each sampling event. It is recommended that the sampling process should be conducted from the least to the most contaminated wells if the information is known.

3.0 Sample Preservation, Containers, Handling and Storage

The type of analysis and matrix being collected determines the type of container, preservation, holding time and filtering requirements to be used in the sampling process. The containers must be laboratory-cleaned, with a Teflon liner in the cap and must be labeled with a sample identification number and other additional data as in the field data sheet and chain-of-custody form.

After logging and labeling, samples shall be appropriately preserved and placed in a cooler at 4°C. they must be shipped before holding time is over, generally within 24 hours since time of collection. Shipment and packing must be adequate to ensure they arrive intact.

4.0 Interference and Potential Problems

Problems with groundwater sampling are usually generated in two primary ways: (1) by collecting a non-representative sample or (2) by handling the sample incorrectly either by utilizing poor quality procedures or untrained personnel. A non-representative sample can be collected if purging is not properly conducted or if excessive pumping is used. Instruments that will be used to collect and handle the samples should be limited to stainless steel, Teflon or glass.

5.0 Equipment

- Water level indicator
- OVA
- Steel brush
- Log book, groundwater sampling form
- Calculator
- Chain-of-custody form
- Sample labels
- Sample containers
- Knife
- Tool box
- Plastic sheets
- Sterilized gloves
- 5-gallon pail (2)
- Health and safety gear
- Shipping containers
- Packing materials
- Ziplock bags
- Containers for extracted purge water
- Tap water
- Non-phosphate soap
- Aluminum soap
- Distilled water
- Bailers
- Teflon-coated wire
- Submersible pump
- 12-volt battery

6.0 Reagents

Any reagent to be utilized for preservation of samples will be specified by the analysis performed.

7.0 Procedures

For purposes of preparation, first should be to determine the extent of the sampling effort, the methods to be employed and the equipment needed. All equipment will be pre-tested and properly decontaminated prior to sampling. A schedule and site survey will be prepared in accordance with a site-specific health and safety plan. The following steps will be undertaken. (Sampling will start at the least contaminated well or background well, if known). A plastic sheet will be placed next to the well to accommodate equipment and materials.

Purging:

1. Date, time, weather and well information must be documented on the appropriate forms.
2. Well caps will be removed and OVA readings will be conducted to determine the presence of volatile organic compounds.
3. Introduce and record the groundwater levels with a water level indicator, making sure reference points are documented.
4. Measure total depth of well.
5. Calculate both the volume of water in the well and the amount to be purged.
6. Conduct purging until three well volumes have been extracted and/or until parameters such as pH, temperature and conductivity have stabilized.
7. If conducted with a bailer, decontaminate the equipment before use, attach the line and lower the bailer until completely submerged. When retrieving the bailer, ensure that the line of the bailer falls on the plastic sheet. Afterwards, empty the bailer into a 5-gallon pail and determine the volume necessary to achieve the required purging. Dispose of the purge water as specified on the site-specific work plan.
8. If a submersible pump is used, this one will consist of a 12-volt electric powered pump, which reaches depths of 60.0 feet. The procedures will be conducted as with the bailer method.
9. If purging is conducted with a hand pump, all quality assurance procedures of the above methods will be followed.

Sampling:

Sampling will be conducted with a non-dedicated Teflon or stainless steel bailer that contains a removable cap for quick and easy cleaning.

1. Place the plastic sheeting around the monitoring well.
2. Lower the bailer slowly into the well until reaching the top of the water surface.
3. Allow the bailer to fill and slowly retrieve the bailer from the well.
4. Quick and carefully remove the cap of the sample container and place it on a clean surface. Begin pouring water slowly from the bailer into the container and replace the cap.
5. Log and label all the samples. Fill out custody forms and pack them carefully for shipment to laboratory.

After all samples are collected and preserved, the equipment should be decontaminated prior to sampling another well. For analyses of volatile organics, turbulence should be minimal and vials must be filled to just overflowing, leaving a convex meniscus on the top before placing the cap. Invert the vial and carefully inspect for 10 seconds if bubbles appear. If this occurs, begin the process again until no air is introduced in the vial. Once the vials are filled, place them in a cooler, lying on its side and protected with a foam protective sleeve. The samples should be maintained at 4°C during the holding period.

8.0 Calculations

To calculate the volume of the well for purging purposes refer to the formulas on SOP # MA-008.

9.0 Quality Assurance / Quality Control

All data and activities will be documented in field data sheets and logbooks. All instrumentation will be pre-tested and used according to the manufacturer's specifications.

10.0 Health and Safety

Various protective programs may be implemented depending upon site-specific contaminants. This can be achieved by using standard safe operating practices to minimize potential contact with contaminants in both the vapor phase and liquid matrix by using respirators or disposable clothing as required.

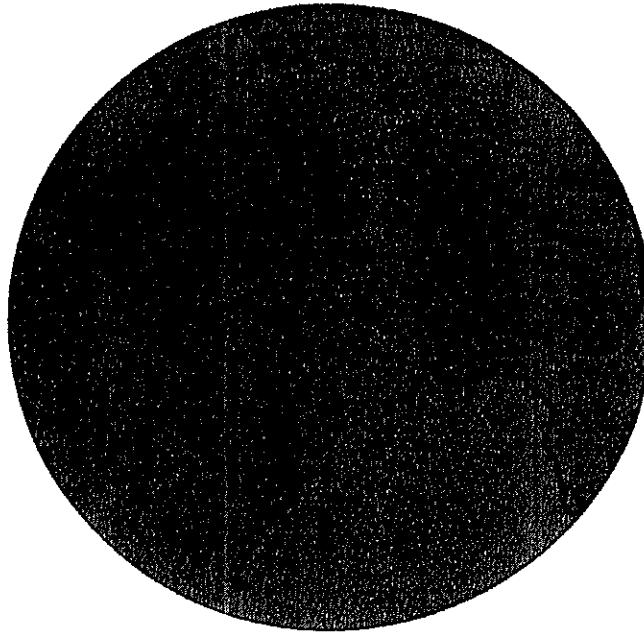
For VOC's avoid breathing near the wells if OVA readings suggest that constituents are venting from this one. Additionally, sampling must be conducted under Level C protection.

Physical hazards associated with sampling may include injuries caused by moving equipment or bailer retrieval, use of knives, heat stress and slip or fall conditions.

Appendix V. Statement of Qualifications



Statement of Qualifications



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Analytical Pharmaceutical & Environmental Services

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HIGH TECHNOLOGY LABORATORY is committed to satisfying customer's needs providing quality, reliable and timely analytical services employing *state-of-the-art* equipment and innovative processes in the hands of the most experienced and thoroughly trained scientific staff.



COMMITMENT TO QUALITY

Our expressed goal of delivering the highest quality service at a cost-effective price has been the cornerstone of HTL since its founding. The precision, accuracy, and customer acceptance of our sampling and analytical services has gained widespread recognition in the industry and has established High Technology Laboratory as a leader of technical excellence. At HTL, quality is the highest priority of every member in the laboratory. Our quality program is designed to support our business principles:

- ◆ Customer Satisfaction
- ◆ Focus on Process as well as Results
- ◆ Prevention versus Inspection
- ◆ Distribute Work Force Expertise throughout the Process
- ◆ Fact-Based Decision Making
- ◆ Maintain Strong Internal and External Communication Links

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High Technology Laboratory (HTL) is a corporation dedicated to providing chemical analyses and environmental services to industry and governmental agencies in Puerto Rico and the Caribbean region. Established in 1991, HTL has been the industry leader in bringing to Puerto Rico the latest technology for environmental analyses.

State-of-the Art Instrumentation: In 1991, we were the first to utilize a Gas Chromatograph/Mass Spectrometer (GC/MS) with an Ion Trap Mass Analyzer. In 1994, we were the first to perform metal analyses using a Simultaneous Inductively Coupled Plasma (ICP) Spectrophotometer with a Segmented-Array Charge-Coupled-Device Detector (SCD) and an axially viewed plasma. With these innovative technologies, HTL can provide its customers with precise results and faster sample processing.

Scientific Staff: Our instrumentation capabilities are augmented by a highly skilled and empowered scientific staff with over 20 years of experience in chemical analyses, method development, FDA (Food & Drug Administration) and environmental compliance issues. Our entire staff is committed to customer satisfaction and prides itself in providing timely services that are reliable and of consistent quality.

Mergers: In January 1995, High Technology Laboratory and Quantum Laboratories joined their operations with the purpose of performing environmental services and chemical analyses under the corporate name of High Technology Laboratory, Inc. Since its founding in 1987, Quantum Laboratories experienced a steady growth in the scope of its analytical services and clientele. Quantum's staff brought to High Technology Laboratory over 15 years of additional experience. This merger of facilities and personnel increased HTL's capacity to provide our clients with a wider range of chemical and contract analytical services; while maintaining our commitment to quality and customer satisfaction.

Acquisitions: In July 1995, Analytical Technologies, Inc. (ATI), a subsidiary of Barcardi Corporation, was also added to HTL's operations. This combination has further increased HTL's capabilities in terms of instrumentation, experience and personnel. Today, HTL is a complete full service, independent testing laboratory with a solid position in the Puerto Rico environmental and contract analytical services market.

New Services: In October 1996, HTL added new analytical services to its existing operations. These services were focused towards the analysis of products and devices manufactured by the Pharmaceutical, Cosmetic and Food industry.

These new services have been widely accepted by our industry partners due to HTL's compliance, reliability, rapid response and cost effectiveness when carrying out projects and product testing activities for these industries. In response to the current trends, client and agency requirements HTL has established Standard Operating Procedures (SOP's), Quality Control systems and has been registered with the Food and Drug Administration and P.R. Health Department to address these requirements. In addition HTL has gone through pre-qualification audits by each client prior to the initiation of laboratory activities. Our scientific staff members are thoroughly trained and qualified in USP, cGMP/GLP compliance and quality issues prior to actively participating in these projects.

Contract Analytical Services for the Pharmaceutical, Cosmetic and Food Industry:

♦ **Research & Development**

At HTL we are committed to providing our clients with the most cost effective and expeditious way of developing new methods for the analysis of pharmaceutical products or, improving existing methodology. This is accomplished by a scientific staff thoroughly trained in the latest analytical techniques. These scientists are supported by a contingent of Doctorate and Masters Degree level staff members. We maintain a regulatory compliance unit that monitors trends in the industry, as well as those changes brought forth by the regulatory agencies, while insuring our own compliance. We also share this information with our pharmaceutical partners, giving them an added value service at no cost.

When transferring methods from research to the manufacturing site they may not run as smoothly as expected. This can consume an enormous amount of time. At HTL we can save your analytical laboratory time, that takes away from the main functions of a QC laboratory operation. The methods are thoroughly evaluated and de-bugged, eliminating any delays in their implementation. The transfer of these methods is carried out using protocols provided by our clients, in the event that one is not available, HTL can provide one and submit it for client approval prior to its implementation. These activities can also assist our clients when their laboratory is overloaded, by using HTL as a qualified alternate testing site.

Among the technologies and methodologies established at HTL are the following:

HPLC Assays

HPLC and GC Impurity Profiles

HPLC Stability Indicating Assays

Release Methods

Gas Chromatography (GC, GC/MS)

Content Uniformity

Dissolutions (Single Point & Profiles)

Spectrophotometric Methods (UV, FT-IR, AAS, AES)

Water Content by Karl-Fisher Titration

Total Organic Carbon (TOC) Analysis

♦ **Cleaning Procedures Validation**

High Technology Laboratory can develop and validate specific methods for the analysis of active and detergent residues in swabs and rinse solutions. These methods can be developed using protocols supplied by our pharmaceutical partners, or a format developed by High Technology. All protocols designed and developed by HTL comply with the current regulatory guidelines and are submitted for client pre-approval prior to implementation. Our services in this area are not limited to the development and validation process, additional support is provided to the client in the selection of cleaning agents and materials used in the cleaning process.



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OUR SERVICES

◆ Process Validation Support Testing Services

Many times analytical laboratories are overwhelmed by the volume of process validation samples submitted from technical services groups. We offer a cost effective alternative to these situations. Using dedicated and qualified scientists we can effectively receive, analyze and report results in the time frame required by our clients. Results can be reported in our standard Certificate of Analysis or one submitted by our client, reducing your operating costs and keeping your process validation commitments on schedule.

◆ Stability Testing

All methods used in testing of stability samples are qualified and/or validated, at HTL's site, prior to their use in the analysis of products. Protocols are strictly followed and results are reported within the time frame our clients and the regulatory agencies require for both RT (Room Temperature) or Accelerated Stability Samples. All supporting data is audited and delivered to the client in hard copy and accompanied by the corresponding Certificates of Analysis. All dosage forms can be accommodated using the best analytical technology available.

◆ USP Raw Material Testing

High Technology Laboratory can analyze a variety of Pharmaceutical Raw Materials, including Bulk Drug Substances, following USP (U.S. Pharmacopeia), BP (British Pharmacopeia) and EP (European Pharmacopeia) methods. All methods are previously qualified using current pharmacopeial guidelines.



Environmental Analytical Services

- ◆ RCRA characterization including TCLP
- ◆ NPDES and PRASA monitoring requirements
- ◆ Stormwater monitoring
- ◆ Underground Storage Tank (UST) monitoring
- ◆ Volatile Organic Compounds (VOC)
- ◆ Semi-volatile Organic Compounds (SVOC)
- ◆ Pesticides & Herbicides
- ◆ Trace metals and impurities
- ◆ PCB's
- ◆ Drinking Water Analysis

Sampling services:

- ◆ Solid wastes (soil, sludge, and multiphasic)
- ◆ Hazardous wastes
- ◆ Industrial waste water discharges
- ◆ Drinking Water
- ◆ Monitoring Wells
- ◆ Site Environmental Assessment
- ◆ Others

Environmental Site Assessments (ESA):

- ◆ Phase I ESA; to determine if a property may be contaminated, with hazardous or toxic substances, as a result of previous activities undergone at the site
- ◆ Phase II ESA; to determine the degree of contamination by means of sampling and analysis of a wide range of pollutants.
- ◆ Phase III ESA; to mimic the superfund remedial investigation/feasibility study and evaluate the results obtained from Phase II ESA

Other analytical services:

- ◆ Food products analysis following AOAC procedures
- ◆ Industrial Hygiene monitoring

Training services in areas such as:

- ◆ Chromatographic Techniques
- ◆ cGMP/GLP and USP
- ◆ Method Validation
- ◆ Cleaning Procedures
- ◆ Analytical Instrumentation
- ◆ Environmental Regulations
- ◆ Sampling Methods
- ◆ Analysis Requirements and Methods
- ◆ Emergency Response for Hazardous Waste Spill Control
- ◆ Customize Environmental trainings



CUSTOMER SATISFACTION

Timely Results

Our goal at HTL is to provide our customers with scientifically and legally defensible data within the time frame required. The results of chemical analyses performed are submitted to clients within a normal turnaround period of 10 to 15 working days or within 24 to 72 hours for clients who need rush service.

Thorough Reports

In addition to the result tables for each analysis performed, HTL's reports include a summary page of the analyses performed and the quality control data necessary to evaluate the validity of the results.

Customize Report Formats

At HTL, we can design report formats that meet our client's specifications and provide the analysis data on a diskette or through electronic mail.

EnviroALERT

This program is designed to inform clients as soon as possible of parameters which exceed regulatory limits. Once a parameter exceeds the regulatory limits, a customer service representative will notify, by telephone, the person requesting the service, allowing him or her to take corrective action promptly.

Technical Assistance

High Technology laboratory maintains a well informed and experienced staff which is available to assist clients with their questions or concerns regarding environmental and analytical issues. Within reasonable time constraints, this assistance is gladly furnished at no cost to the client.

Confidentiality

All analysis results and raw data are kept confidential and remain on file at our facilities for at least three years. These documents are available upon the request of the client.



HTL's Quality Assurance Program

The major function of an independent laboratory is to generate technical information. At HTL, this information consists of the results of chemical analyses, along with the auxiliary information necessary for the proper interpretation of these results. Our clients need this information for various reasons: to demonstrate compliance with government regulations, to evaluate raw materials, or to decide a legal dispute, among others. Aware that this information is important to our clients, it becomes more important for us at HTL to produce it under a program that will assure its quality, i.e., that it has the degree of accuracy commensurate with its intended use.

High Technology Laboratory has implemented a Quality Assurance Program in compliance with the general quality system requirements of cognizant accreditation associations and federal and local government regulatory agencies, such as:

- ◆ **American Association for Laboratory Accreditation (A2LA)**
General Requirements for the competence of calibration and testing laboratories (ISO/IEC Guide 25-1990).
- ◆ **U.S. Environmental Protection Agency (EPA)**
 - a) Chapter 40 of the Code of Federal Regulations (CFR), part 136 - Guidelines establishing test procedures for the analysis of pollutants.
 - b) Chapter 1 QA/QC for methodology SW-846 - Test methods for evaluating solid waste: Field and Laboratory Manuals.
- ◆ **Puerto Rico Aqueduct & Sewer Authority (PRASA)**
"Programa de auditorías a laboratorios químicos privados que prestan servicios a la Autoridad o realizan pruebas de automonitoría".
- ◆ **American Public Health Association (APHA), American Water Works Associations (AWWA) and the Water Environment Federation**
Parts 1020 Quality Assurance of the Standard Methods for the Examination of Water and Wastewater Manual.
- ◆ **Environmental Quality Board (EQB)**
Information submitted to the EQB Land Pollution Control Area for sampling and analysis activities. Document Number: QAD-01/EQB/LPCA/QAD/SAIP.
- ◆ **Federal Food and Drug Administration (FDA)**
Chapter 21 of the Code of Federal Regulations (CFR), part 58 - Non-clinical Laboratory Studies and Good Laboratory Practices (GLPs) regulations.
- ◆ **State of Florida Department of Health & Rehabilitative Services**
Successful participation in the Laboratory Certification Program.
- ◆ **Puerto Rico Department of Health**
Laboratory Certification Program

Clients

Below is a partial listing of our clients and the projects that we have been awarded.

- ◆ Bacardi Corporation
- ◆ Schering Plough Products, Inc.
- ◆ Warner-Lambert, Inc.
- ◆ Eli Lilly Industries, Inc.
- ◆ Faulding of Puerto Rico, Inc.
- ◆ Ohmeda of Puerto Rico, Inc.
- ◆ Ocular Sciences
- ◆ Federal Packing de P.R.
- ◆ Biovail Laboratories, Inc.
- ◆ Procter & Gamble Pharmaceuticals, Inc.
- ◆ PROTECO
- ◆ Induchem Environmental Services
- ◆ Puerto Rico Aqueduct & Sewer Authority (PRASA)
- ◆ Puerto Rico Electric & Power Authority (PREPA)

Projects

Several projects have been carried out at HTL, but, the confidentiality agreements with the clients do not allow us to mention the titles of the projects. These projects include, among others:

- ◆ HPLC Method Development & Validation for assays of active drugs substances
- ◆ HPLC Method Development & Validation for Residues and/or impurities in final products
- ◆ GC Method Development & Validation for the determination of residues from cleaning procedures
- ◆ GC Method Validation for Assays of active drugs substances
- ◆ GC Method Validation for determination of impurities in active drug substances
- ◆ TLC Method Validations for assays of active drug substances
- ◆ UV Method Validations for assays of active drug substances
- ◆ THC determination in compressed air
- ◆ Environmental Site Assessment Phase I, II, III
- ◆ UST Tank Removal sampling and analysis
- ◆ RCRA Hazardous Waste Characterizations
- ◆ NPDES and PRASA Monitoring for permit compliance



INSTRUMENTS & FACILITIES

Our laboratory instruments include but are not limited to:

- ◆ HPLC (High Performance Liquid Chromatography) (2)
- ◆ Gas Chromatograph/Mass Spectrometer (GC/MS) with Ion Trap Mass Analyzer (3)
- ◆ Gas Chromatograph (GC) equipped with a variety of detectors - (4)
- ◆ Purge and Trap systems (3)
- ◆ Headspace analysis system
- ◆ Simultaneously Inductively Coupled Plasma (ICP) Atomic Emission Spectrophotometer with a Segmented-array Charge-coupled-device Detector (SCD) and an axially viewed plasma
- ◆ Atomic Absorption (AA) Spectrophotometers with standard and high temperature burner, graphite furnace and mercury cold vapor generation systems - (2)
- ◆ UV-Vis Spectrophotometer - (2)
- ◆ Total Organic Carbon Analyzer (TOC)
- ◆ Extraction Apparatus for Toxicity Characteristic Leaching Procedure (TCLP)
- ◆ Lachat Autoanalyzer
- ◆ Microwave Oven for acid sample digestions - (2)
- ◆ Sampling Equipment

These instruments and others are distributed among ten rooms of our modern laboratory. Our new facilities cover a total area of approximately 8,500 square feet which provides ample space for sample receiving and storage and for performing various types of chemical analyses. HTL's laboratory and administrative operations are fully automated. Our Novell 3.11 computer network, with a capacity for 20 users, currently serves 15 personal computers with applications such as: Sample Analytical Management (SAM), Microsoft Office (Word, Excel, Access and Powerpoint) and Electronic Mail among others.



STAFF & SUPPORT

HTL Staff

Below is an outline of the organizational structure of HTL. On the following pages you will find a summary of the qualifications and experience of our corporate directors, a table listing the academic preparation of our regular/full-time personnel and our organizational chart.

Our Scientific Staff:

- ◆ Directors (licensed chemists)
 - * Edgard Resto Ph.D. in Chemistry
 - * Federico Asmar M.S. in Chemistry
- ◆ Laboratory Supervisors, Analysts & Technicians
 - * Six (6) licensed Chemists
 - * One (1) Chemist
 - * One (1) Biologist
 - * Seven (7) staff members with various science degrees

Our Administrative and Laboratory Support Teams:

- ◆ Administrative Services personnel (Finance & Human Resources)
- ◆ Safety & Health Officer
- ◆ Waste Minimization Officer
- ◆ Field Operations Supervisor
- ◆ Customer Service Representatives
- ◆ EDP Officer
- ◆ Three (3) Administrative Assistants
- ◆ Three (3) Field Technicians
- ◆ Two (2) Maintenance/Sanitation Assistants



Professional Memberships

HTL and its staff are members of the following professional organizations:

- ◆ American Association for the Advancement of Science (AAAS)
- ◆ American Association for Laboratory Accreditation (A2LA)
- ◆ American Chemical Society (ACS)
- ◆ American Institute of Chemical Engineering
- ◆ American Public Health Association (APHA)
- ◆ American Society for Quality Control (ASQC)
- ◆ American Water Works Association (AWWA)
- ◆ Asociación Interamericana de Ingeniería Sanitaria y Ambiental (AIDIS)
- ◆ Association of Official Analytical Chemists (AOAC)
- ◆ Cámara de Comercio de Puerto Rico
- ◆ Colegio de Químicos de Puerto Rico
- ◆ Puerto Rico Manufacturers Association - Environmental Committee
- ◆ Asociación de Productos de Puerto Rico

Registered Supplier

HTL has submitted the documents required to be included in the Registry of Qualified Suppliers of the following government agencies.

- ◆ Puerto Rico Aqueduct & Sewer Authority
- ◆ Puerto Rico Electric & Power Authority
- ◆ Puerto Rico General Services Administration - No. 2235
- ◆ Drinking Water by PR Department of Health
- ◆ Food & Drug Administration (FDA) - No. 2650244

Corporate Directors

Edgard Resto, Ph.D., is a graduate of the University of Puerto Rico at Río Piedras where he obtained a Bachelor of Science in Chemistry with a minor in Mathematics, a Master of Science in Analytical Chemistry and a doctoral degree in Biochemistry with a minor in Analytical Chemistry. During 1988 and 1990, he was a Research Associate and Post-doctorate Fellow at the University of Virginia at Charlottesville. In August of 1990, he joined the science faculty at the University of Turabo as Assistant Professor in Chemistry. In addition to teaching undergraduate chemistry courses, he is the Faculty Leader responsible for the development of a graduate program in Environmental Science, including the preparation of seven environmental or analytical graduate courses. Also was the Project Director of the Bioremediation Education, Science and Technology (BEST) center at the Ana G. Méndez University System from 1992 to 1997. He currently serves as a science collaborator on two environmental research projects, one at Lawrence Berkeley Laboratory in California and the other at the University of Puerto Rico at Río Piedras. President 1996-97 of the "Colegio de Químicos de Puerto Rico" and member of the CQPR Board since 1995 to 1997. In 1990, he founded High Technology Laboratory with fellow chemist, Federico Asmar, where he serves as Director of Administration and Special Projects.

Federico Asmar, M.S., is a graduate of the University of Puerto Rico at Río Piedras (UPR) where he obtained a Bachelor of Science in Chemistry and a Master of Science in Physical Chemistry with a minor in Analytical Chemistry. He has only to submit a final research proposal and present his research thesis to complete all the degree requirements for the Doctoral Program in Chemistry at UPR. During 1988-1993, he taught undergraduate chemistry courses at the University of Puerto Rico in Río Piedras and at the University of Turabo and was a Research Associate at UPR. He has over seven years of experience in Research and Development in chromatographic techniques (HPLC and TLC), Laser Spectroscopy and Laser Mass Spectrometry and in the development of analytical and instrumentation applications, including the interfacing of analytical instrumentation to computers. In 1990, he founded High Technology Laboratory with fellow chemist, Edgard Resto, where he serves as Laboratory Director.



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STAFF & PERSONNEL QUALIFICATIONS

HTL Academic Preparation of Personnel

Name	Position	Degree	Chemist License	University
1) Edgard Resto	Quality Assurance Unit (QAU) Director & Administration Director	Ph.D., Chemistry M.S., Chemistry B.S., Chemistry	Q02534	Univ. of Puerto Rico, Rio Piedras
2) Federico Asmar	Laboratory Director	M.S., Chemistry B.S., Chemistry	Q02471	Univ. of Puerto Rico, Rio Piedras
3) Mei-Ling Nazario	Supervisor of Pharmaceutical and Metals Analyses divisions Safety & Health Officer	B.S., Chemistry M.S., Environmental Management (in prog.)	Q03872	Univ. of Puerto Rico, Rio Piedras Metropolitan University (FEAGM), Cupey
4) Annabelle Morris	Supervisor of Wet Chemistry division and Preparation Division	B.S. Chemistry	Q01802	Central University Bayamon
5) Rafael Perez	Laboratory Analyst	B.S. Chemistry	Q02907	Univ. of Puerto Rico, Rio Piedras
6) Omar Lozada	Laboratory Analyst	B.S. Chemistry	Q04361	Univ. of Puerto Rico, Rio Piedras
7) David Ramos	Laboratory Analyst	B.S. Biology	--	Interamerican Univ., Bayamon
8) Karlene Gumbs	Laboratory Analyst	B.A. Chemistry	--	Interamerican Univ., Arecibo
9) Diana Stauri	Laboratory Analyst	B.S. Chemistry	--	Univ. of Puerto Rico, Cayey
10) Yessenia Gomez	Laboratory Analyst	B.S. Biology	--	Univ. del Turabo, Caguas, PR
11) Josue Ortiz	Laboratory Technician	B.S. Chemistry	--	Univ. of Puerto Rico, Rio Piedras
12) Leila Calderon	Laboratory Technician	A.S. Chemical Eng.	--	Technical Institute of P.R.
13) Jose Ocasio	Laboratory Technician	A.S. Chemistry	--	San Juan Technical Institute of P.R.
14) Edgard Resto Nuñez	Laboratory Technician	H.S. Graduate	--	Escuela Técnica Padilla de Sanz



HIGH
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STAFF & PERSONNEL QUALIFICATIONS

HTL Academic Preparation of Personnel

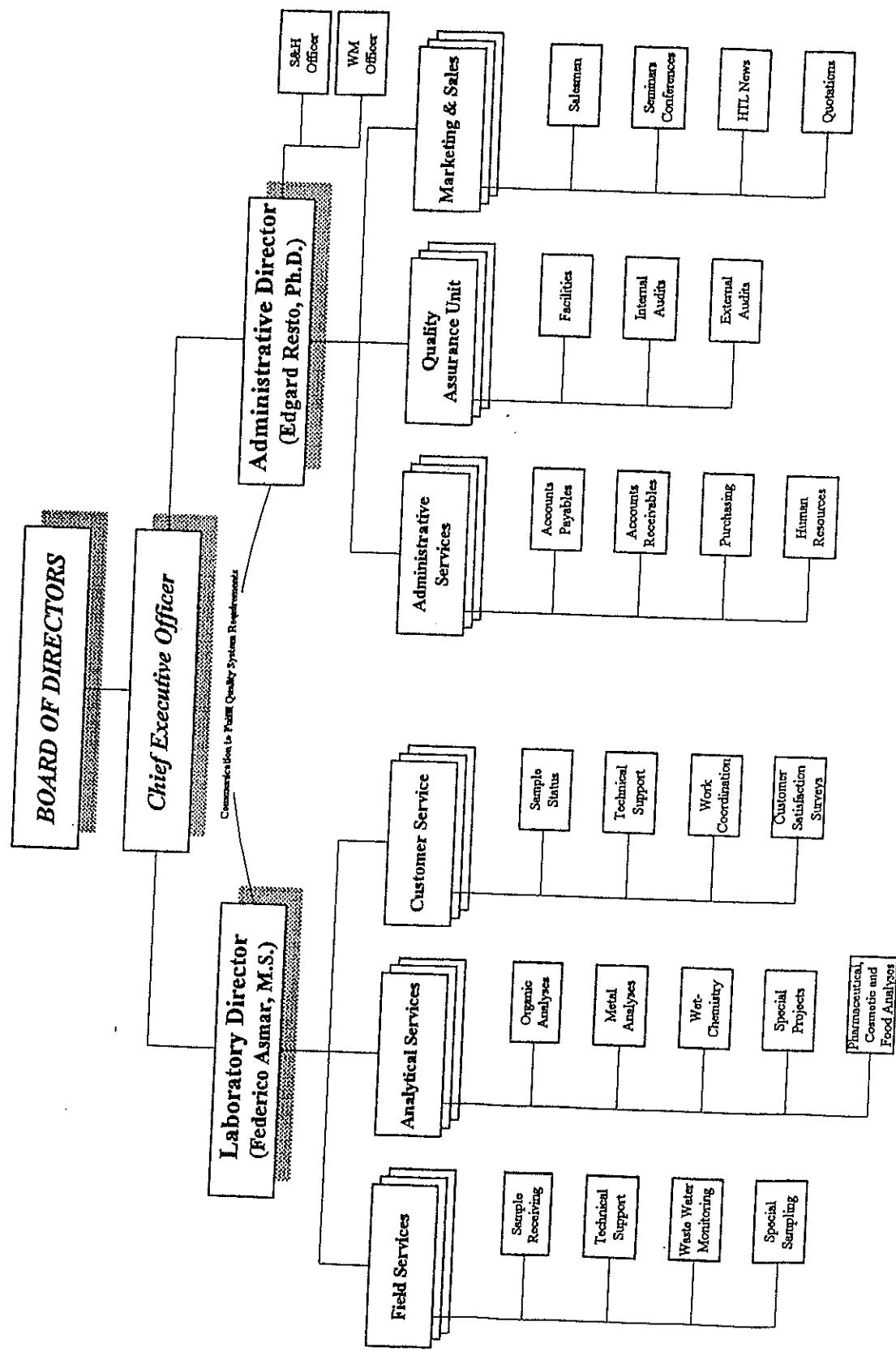
Administration and Laboratory Support

Name	Position	Degree	Degree Major	University
1) Vicente Pérez	Field Operations Supervisor	Certificate	Computers	Electronic College
2) Luis Colón	Field Technician	A.S.	Environmental Engineering	Inst. Técnico de P.R. Ponce
3) Luis Sáez	Field Technician	A.S.	Environmental Engineering	Inst. Técnico de P.R. , Ponce
4) Lizbeth Torres	Secretary/Administrative Assistance	H.S. Graduate/A.S.	--	
5) Denisse Gutiérrez	Secretary/Administrative Assistance	H.S. Graduate/A.S.	--	
6) Luis F. Mieses	Maintenance/Receiving Assistant	H.S. Diploma	Chemistry	University of Illinois
7) Julio Rodriguez	Pharmaceutical Division Client and Project Developer	B.S. Chemistry		



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ORGANIZATIONAL CHART





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Environmental Services
P.O. Box 366650 San Juan, P.R. 00936-6950

FIELD INFORMATION

SAMPLER'S NAME:
Zoe Atances

U.S.-Carolina

Grand Water

SAMPLING SITE LOCATION:
San Juan, P.R. 00908

Tel: (787) 793-7288
Fax: (787) 792-9280

PROJECT NUMBER:

NORMAL RUSH (24 HRS)
RUSH (72 HRS) RUSH (5 Days)

DATE: 06-12-01
TIME: 3:45pm

CUSTOMER: Land Fill Technology

CONTACT PERSON: Zoe Atances

HTL CONTACT PERSON: Federico Asmar

PROJECT DESCRIPTION: URS Carolina

REPORT TO: Zoe Atances PHONE: 273-7639

FAX: 273-8315

ADDRESS: P.O. Box 13487

DATE/TIME LEAVING HTL:

DATE/TIME ARRIVING FACILITIES:

DATE/TIME SAMPLING START: 06-26-01

DATE/TIME SAMPLING FINISH:

RECEIVED: BY:

DATETIME OF SAMPLE ACTIVITIES:

DATE/TIME LEAVING HTL:

DATE/TIME ARRIVING FACILITIES:

DATE/TIME SAMPLING START: 06-26-01

DATE/TIME SAMPLING FINISH:

SAMPLE TYPES:

ADDITIONAL FORMS:

COC:

AFT:

NONE:

TEMP (°C):

pH (PH UNITS):

ALKALINITY:

BICARBONATE:

CHLORIDE:

CONDUTIVITY:

FLASHPOLINT:

FLUORIDE:

GARNESS:

METALS:

NO_x/NO₂:

ODOR:

PCBS:

PCP:

PCP-PEST:

PCBS DRO OTHERS:

PP OTHERS:

RO:

SO₂:

TCI:

TAL:

TOX:

TPH:

TPX:

USP-DOL:

SULFIDE:

CYANIDE:

PHENOLICS:

OIL & GREASE:

COD:

T.PHOSPHOROUS:

TRK:

NO_x:

NH:

SS:

TDS:

SULFATE:

METAS:

HAZARNESS:

FLASHPOINT:

COLIFORM:

OR(VI):

CONDUTIVITY:

FLASHPOINT:

FLUORIDE:

GRASS:

ALKALINITY:

BICARBONATE:

CHLORIDE:

CONDUTIVITY:

FLASHPOINT:

FLUORIDE:

GRASS:

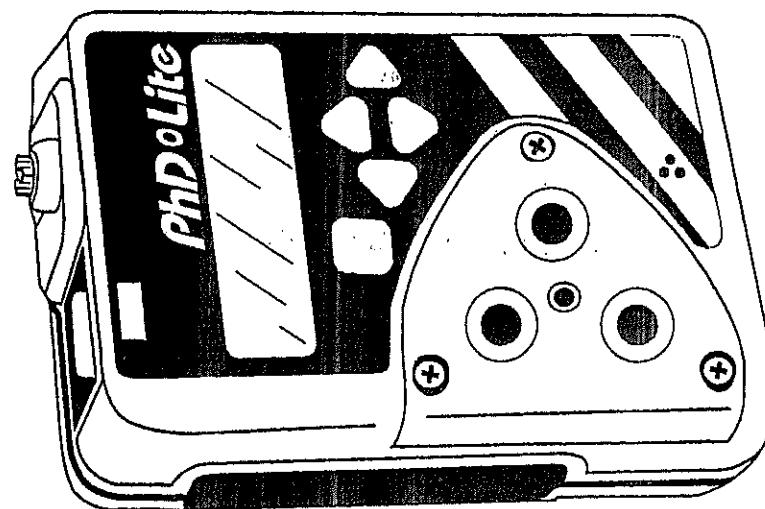
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Appendix VI. Calibration Procedures

Reference Manual for
PhD Lite
Multi Gas Detector

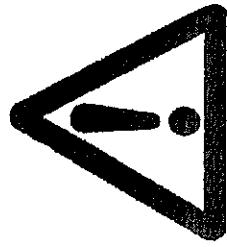


biosystems

651 South Main Street
Middletown, CT 06457
860-344-1079
FAX 860-344-1068
www.biosystems.com
080399 / Version 2.6

WARNING

THE PhD LITE
PERSONAL PORTABLE
GAS DETECTOR HAS
BEEN DESIGNED FOR
THE DETECTION OF
OXYGEN DEFICIENCIES,
FLAMMABLE GAS, AND
TOXIC VAPOR
ACCUMULATIONS.



IN ORDER TO ASSURE THAT THE USER IS
PROPERLY WARNED OF POTENTIALLY
DANGEROUS ATMOSPHERIC CONDITIONS, IT IS
ESSENTIAL THAT THE INSTRUCTIONS IN THIS
MANUAL BE READ, FULLY UNDERSTOOD, AND
FOLLOWED.

AVERTISSEMENT: LIRE ATTENTIVEMENT LES
INSTRUCTIONS AVANT DE METTRE EN MARCHE.

PhD Lite Operation Manual
Copyright 1998
by
Biosystems
Middleton, Connecticut 06457

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Introduction

The PhD Lite is a personal, portable, microprocessor controlled gas detector that can monitor up to four atmospheric hazards simultaneously: oxygen, combustible gas, carbon monoxide, and hydrogen sulfide. The PhD Lite allows you to choose specific sensors for the detection of CO or H₂S when you have only one toxic hazard to deal with; or choose Biosystems' dual channel CO/H₂S sensor to measure both CO and H₂S when both hazards are simultaneously present.

The PhD Lite uses a front-mounted, graphics LCD (liquid crystal display) to simultaneously show readings of the gases being measured. A loud audible alarm and alarm light are used to warn users when the concentrations of measured contaminants exceed the alarm set points.

The PhD Lite offers a choice of three modes of operation, providing the right amount of information for users with different skill levels. The PhD Lite microprocessor software allows true one-button operation. All procedures necessary for day to day operation, including automatic calibration adjustment, are controlled through the single "on / off" mode button. Four navigation buttons are used to make use of advanced procedures and setup choices. Biosystems EEPROM equipped "Smart Sensors" automatically let the instrument know which sensors are currently installed, assign the appropriate alarm settings, and let the instrument know if any changes have been made to the sensors since the last time the instrument was turned on. The PhD Lite is powered by either a set of three disposable AA alkaline batteries or a rechargeable nickel metal hydride (NiMH) battery pack. Either set of batteries are designed to provide up to 12 hours of continuous use.

The PhD Lite has been Classified as to intrinsic safety by the following testing laboratories:

European Community (DEMKO Certificate number 99E.12499X), EEx ia IIC T4 for instruments powered using DEMKO approved alkaline batteries & EEx ai IIC T3 for NiMH powered instruments.

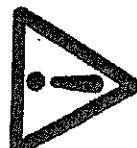
Underwriters Laboratories Inc. (file number E109447) and the Canadian Standards Association International (Standard ID CSA 22.2 No. 152 Certificate number LR 92645-13) for use in Hazardous Locations Class I, Division 1, Groups A, B, C, and D.

The PhD Lite is also CE-Marked ((Conformité Européenne). The UL, CSA, and DEMKO classifications marks indicate compliance with United States, Canadian, and European Community requirements. These classifications extend to instruments when operated with the motorized pump.

Classification for intrinsic safety is based on tests conducted in explosive gas / air (21 % oxygen) mixtures only. The PhD Lite

should not be used for combustible gas monitoring in atmospheres where oxygen concentrations exceed 23.5 % oxygen.
ONLY THE COMBUSTIBLE GAS DETECTION PORTION OF THIS INSTRUMENT HAS BEEN ASSESSED FOR PERFORMANCE BY THE CANADIAN STANDARDS ASSOCIATION INTERNATIONAL.

UNIQUEMENT, LA PORTION POUR DÉTECER LES GAZ COMBUSTIBLES DE CET INSTRUMENT A ÉTÉ ÉVALUÉE PAR LE CANADIAN STANDARDS ASSOCIATION INTERNATIONAL.



WARNINGS AND CAUTIONS

1. Caution: The PhD Lite personal, portable gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicating the presence of a potentially life threatening hazard should be taken very seriously.

In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and return only after further testing together with other appropriate safety procedures determine that the area is once again safe for entry.

2. Warning: Use only Duracell MN1500 or Ultra MX1500, Energizer E91-LR6, Eveready EN91(not DEMKO approved), Radio Shack 23-874(not DEMKO approved) size AA, 1.5V Alkaline batteries, Eveready CH115(not DEMKO approved) or Radio Shack 23-149(not DEMKO approved) size AA 1.2V NiCAD batteries, or Eveready L91 size AA 1.5V Lithium batteries (not CSA or DEMKO approved). Substitution of batteries may impair intrinsic safety.
3. Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.

- 4. Caution:** Accuracy of the PhD Lite must be checked with known concentration calibration gas before each day's use.
- 5. Caution:** Use of non-standard calibration materials may lead to dangerous error as well as exposure to contaminants by testing with known concentration test gas before further use.
- 6. Caution:** The accuracy of the PhD Lite should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.
- 7. Warning:** A sensor which cannot be calibrated or which is found to be out of tolerance should be replaced immediately. An instrument which fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.
- 8. Warning:** Do not reset the calibration gas concentration unless you are using a calibration gas concentration which differs from that normally supplied by Biosystems for use in calibrating your instrument.

- 9. Warning:** Use of non-standard calibration gas and / or calibration kit components when calibrating your PhD Lite can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.
- Biosystems** offers calibration kits and long lasting cylinders of test gas specifically developed for easy PhD Lite calibration. Customers are strongly urged to use only Biosystems calibration materials when calibrating their PhD Lite.
- 10. WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.**
AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSEQUE.
- 11. CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND THE INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING OR SERVICING.**
ATTENTION: POUR DES RAISONS DE SÉCURITÉ, CET ÉQUIPEMENT DOIT ÊTRE UTILISÉ, ENTRETENU ET RÉPARÉ

**UNIQUEMENT PAR UN PERSONNEL
QUALIFIÉ. ÉTUDIER LE MANUEL
D'INSTRUCTIONS EN ENTIER AVANT
D'UTILISER, 'ENTREtenir OU DE RÉPARER
L'ÉQUIPMENT.**

- 12. CAUTION: ANY RAPID UP-SCALE READING FOLLOWED BY A DECLINING OR ERRATIC READING MAY INDICATE A GAS CONCENTRATION BEYOND UPPER SCALE LIMIT WHICH MAY BE HAZARDOUS.**

**AVERTISSEMENT: TOUTE LECTURE
RAPIDE ET POSITIVE, SUIVIE D'UNE BAISSE
SUBITE AU ERRATIQUE DE LA VALEUR,
PEUT INDICER UNE CONCENTRATION DE
GAZ HORS GAMME DE DÉTECTION QUI
PEUT ÊTRE DANGEREUSE.**

Chapter 1. PhD Lite Description

1.1. PhD Lite capabilities

The PhD Lite is a gas detector with features which can be selected to meet your requirements. This chapter discusses some of those features.

1.1.1. Methods of sampling

The PhD Lite may be used as either a "Diffusion" or "Sample-Draw" type monitoring device.

In normal operation, the PhD Lite detector is worn on the belt, used with its shoulder strap, or held by hand. Once turned on, the PhD Lite monitors continuously. The atmosphere being measured gets to the sensors by diffusing through vents in the sensor compartment cover. Normal air movements are enough to carry the sample to the sensors. The sensors react immediately to changes in the concentrations of the gases being measured. This type of "diffusion" operation monitors only the atmosphere which immediately surrounds the detector.

It is possible to use the PhD Lite to sample locations which are remote from the instrument by using a sample-draw kit. A hand-aspirated sample-draw kit is included as an accessory with every PhD Lite. During remote sampling a squeeze bulb is used to draw the sample in through the a probe assembly, and suck the sample through a length of hose back to the instrument. The other method of sample draw uses a battery-operated continuous mechanical pump. Use of the sample draw kits is covered in Chapter 2.

1.1.2. Multi-sensor capability

The PhD Lite can be configured to simultaneously monitor one, two, three, or four gases. Sensors can be added, deleted, changed, or replaced in the field.

The PhD Lite microprocessor and "Smart Sensor" circuitry eliminates the need for manual switch setting and other laborious set-up procedures. (It is still necessary to verify the accuracy of the PhD Lite by calibration with known concentration test gas whenever a change is made to the sensors installed in the instrument.)

The PhD Lite design uses highly specific, electrochemical toxic sensors that have been designed to minimize the effects of common interfering gases. These sensors provide accurate, dependable readings for toxic gases commonly encountered

during confined space entry and other industrial applications.

Toxic sensors available for use in the PhD Lite include hydrogen sulfide (H₂S), carbon monoxide (CO), sulfur dioxide (SO₂) phosphine (PH₃), ammonia (NH₃), chlorine (Cl₂) chlorine dioxide (ClO₂), hydrogen cyanide (HCN), nitric oxide (NO) and nitric dioxide (NO₂). In addition to sensors designed to measure specific toxic hazards, Biosystems offers a dual channel electrochemical sensor designed to detect both carbon monoxide and hydrogen sulfide individually. This dual channel sensor, the "Duo Tox", is like having two sensors in one. The 2 channels allow both CO and H₂S to be detected simultaneously without cross interference.

Biosystems also offers an economical general purpose electrochemical sensor designed to detect both carbon monoxide and hydrogen sulfide. The "CO Plus" sensor is ideal for situations requiring use of a single sensor to monitor for both carbon monoxide and hydrogen sulfide where the user does not need to know specifically which gas is present.

Different measurement units are used depending on the gas being measured:

Type of Hazard	Measurement unit
Oxygen (O ₂)	Percentage of air by volume
Combustible gas	Percentage of lower explosive limit (LEL)
Carbon monoxide (CO)	Parts per million in air
Hydrogen sulfide (H ₂ S)	Parts per million in air
Sulfur dioxide (SO ₂)	Parts per million in air
Phosphine (PH ₃)	Parts per million in air
All other toxic sensors	Parts per million in air

Table 1.0. PhD Lite Units of Measurement

Sensor configuration
procedures are discussed in greater detail in section 2.5.

1.1.3. Calibration

The PhD Lite detector has been designed for easy calibration without the use of manually adjusted calibration pots.

Caution:
Accuracy of the PhD Lite should be checked with known concentration calibration gas before any daily period of use.

Accuracy may be verified at any time while the instrument is in normal operation. Pressing the on / off mode button three times within two seconds places the instrument in the "Auto-Calibration Mode". Adjustments are made automatically simply by pressing the on / off mode button.

Auto-calibration is a two step procedure. In the first step the PhD Lite is taken to an area where the atmosphere is fresh and a "zero" adjustment is made automatically by pressing the on / off mode button.

The second step is the sensor response or "span" calibration adjustment. In this step the accuracy of the PhD Lite sensors is verified by exposing them to known concentration calibration gas. Once again, if necessary, the sensitivity or "span" is adjusted automatically.

Calibration procedures are discussed in detail in Chapter 3.

Use of these procedures is reserved for authorized personnel.

1.1.4. Alarm logic

PhD Lite gas alarms are user adjustable and may be set anywhere within the range of the detector channel. When an alarm set point is exceeded a loud audible alarm sounds, and a bright red LED alarm light flashes.

PhD Lite gas alarms are normally of the self-resetting type. When readings drop back below the pre-set alarm levels, the instrument reverts back to normal

operation, and the visual and audible alarms cease.

It is possible, if desired, to set PhD Lite gas alarms so that they "latch". In the latched condition, once an alarm occurs both visual and audible alarms continue to sound even after the atmospheric hazard has cleared. The instrument must be manually reset before the alarms are silenced.

1.1.5. Atmospheric hazard alarms

Caution: The PhD Lite Personal portable gas detector has been designed for the detection of oxygen deficiencies, flammable, gas, and toxic vapor levels. An alarm condition indicating the presence of one or more of these potentially life-threatening hazards should be taken very seriously.

In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and return only after further testing together with other appropriate safety procedures determine that the area is once again safe for entry.

The combustible gas alarm is activated when the percent LEL (Lower Explosive Limit) gas concentration exceeds the pre-set alarm point.



Caution: A rapid up-scale reading followed by a declining or erratic reading may indicate a hazardous combustible gas concentration which exceeds the PhD Lite zero to 100 percent LEL detection range.

Two oxygen alarm set points have been provided; one for low concentrations associated with oxygen deficiencies and one for high concentrations associated with oxygen enrichment. Three alarm set points have been provided for each toxic gas monitored: TWA (Time Weighted Average), STEL (Short Term Exposure Limit), and Ceiling. Appendix A discusses alarm levels and factory default alarm settings. The procedures for adjusting alarm set points are discussed in Chapter 4.

mode button. The alarm will continue to sound every fifteen minutes until the voltage drops to the "Very Low Battery" level.

When battery voltage has reached the "Very Low Battery" level it is no longer safe to continue to use the instrument with the current set of batteries. It is no longer possible to silence the low battery alarms and it is necessary to leave any hazardous area in which the instrument is being used immediately.

When the voltage drops further the PhD Lite will display a "Dead Batt" message to warn the user of imminent shut down. The instrument will then automatically turn itself off.

After any low battery alarm the batteries should be replaced if the PhD Lite is equipped with alkaline batteries or the battery should be recharged if the PhD Lite is equipped with a NiMH rechargeable battery.

Use only Duracell MN1500 or Ultra MX1500, Energizer E91-LR6, Eveready EN91 (not DEMKO approved), Radio Shack 23-874 (not DEMKO approved) size AA, 1.5V Alkaline batteries, Eveready CH15 (not DEMKO approved) or Radio Shack 23-149 (not DEMKO approved) size AA 1.2V NiCad batteries, or Eveready L91 size AA 1.5V Lithium batteries (not CSA or DEMKO approved). Substitution of batteries may impair intrinsic safety.

appropriate alarms and cause the display of the appropriate explanatory message.

1.1.7. Other alarms and special microprocessor features

PhD Lite software includes a number of additional alarms designed to safeguard proper use of the instrument. When the PhD Lite detects that an electronic fault or failure condition has occurred the proper audible and visual alarms are activated and an explanatory message will be displayed.



Caution: The PhD Lite is designed to detect potentially life threatening atmospheric conditions. Any alarm condition should be taken seriously. The safest course of action is to immediately leave any potentially hazardous location and return only after the nature of the alarm condition has been ascertained, and further testing together with other appropriate safety procedures determine that the area is once again safe for entry.

1.1.7.1. Other electronic safeguards

Several automatic programs prevent tampering and misuse of the PhD Lite by unauthorized persons. Each time the detector is turned on, an electronic self-test is performed that assures the user of proper performance. The sensors, the LED alarm light, and audible alarm are automatically tested, and the battery is monitored continuously for proper voltage. Any detected electronic faults cause the activation the

1.1.7.2. Security beep

The PhD Lite may be optionally set-up to periodically "beep" to indicate that the instrument is turned on. Adding a security beep as well as making use of other optional set-up choices is done through the Instrument Setup Menu described in Section 4.3.

1.1.8. Classification for intrinsic safety

The PhD Lite has been Classified as to intrinsic safety by the following testing laboratories: European Community (DEMKO) Certificate number 99E.12499X, EEx ia IIC T4 for instruments powered using DEMKO approved alkaline batteries & EEx ai IIC T3 for NiMH powered instruments. Underwriters Laboratories, Inc. file number E109447, and the Canadian Standards Association International (Standard ID CSA 22.2 No. 152 Certificate number LR 92645-13) for use in Hazardous Locations Class I, Division 1, Groups A, B, C, and D.

The PhD Lite is also CE-Marked (Conformité Européenne). The UL, CSA, and DEMKO classifications marks indicate compliance with United States, Canadian, and European Community requirements. These classifications extend to instrument when operated with the motorized pump.

1.1.9. Low battery alarms

1.1.9.1. Low battery alarms

Alarms will be activated whenever battery voltage is too low to allow the safe operation of the instrument. When the battery voltage is reduced to approximately 3.3 Volts, an audible alarm sounds, and the display screen indicates a low battery condition exists. At this stage, the low battery alarms may be silenced for a fifteen minute period by pressing the

1.1.9. Options

" icon located in the upper left hand corner of the LCD display indicates that the pump is attached and in normal operation. Low flow or other pump fault conditions activate an audible alarm and cause the display of the appropriate explanatory message.

The PhD Lite measures oxygen, combustible gas, and up to two additional toxic gases. The PhD Lite may be configured as a one, two, or three sensor design. When the "Duo Tox" dual channel CO/H₂S sensor is installed, the instrument is capable of displaying readings for four channels of detection: O₂, LEI, CO and H₂S. The sensor configuration may be changed or added to in the field, or specified at the time of purchase.

Note: Only the combustible gas detection portion of this instrument has been assessed for performance.

1.1.9.2. Continuous sample draw pump

An optional slip-on, motorized sample-draw pump is available for situations requiring continuous "hands free" remote monitoring.

The pump contains a unique pressure sensor which detects water or other fluids being sucked into the unit, and immediately acts to shut off the pump in order to protect the sensors, pump, and other PhD Lite components from damage.

Pump status is continuously monitored by the PhD Lite microprocessor. An animated

1.1.9.3. Remote Vibrating Alarm (MHP-1)

The PhD Lite can be equipped with an optional remote vibrating alarm for use in noisy atmospheres. The MHP-1 remote alarm connects from the instrument to the user via a 20' or 40' cable, and is designed to be worn on the belt, shirt collar, or placed inside a pocket. During an alarm condition the MHP-1 will vibrate continuously until the alarm condition is resolved.

Note: The MHP-1 will not work if the PhD Lite was not ordered with the remote alarm connector and must be sent back to the factory for modification.

1.2. PhD Lite design components

(1) **Case:** The instrument is enclosed in a solid, metal plated ABS case. A water resistant PVC gasket between the upper and lower sections of the case protects against leakage or exposure to liquids.

(2) **Front face:** The front face of the instrument houses the graphics capable LCD display, on / off "Mode" button, four navigation buttons, alarm light port, and audible alarm port.

(3) **LCD display:** A graphics capable liquid crystal display (LCD) meter allows display of readings, messages, menu and other information. A manually activated backlight allows the display to be read even in dim light conditions.

(4) **Alarm light:** A bright red LED (light emitting diode) alarm light provides a visual indication of alarm state. The light is visible from the front, top, or side of the instrument.

(5) **Control buttons:** The large rectangular push-button is called the "Mode" button. It is used to turn the PhD Lite on and off as well as to control most other



1.3. PhD Lite accessories

Each PhD Lite is delivered in a foam lined box containing: the PhD Lite detector with a sample draw / calibration adapter, hand-aspirated sample-draw kit (with 10 feet of sample draw tubing), 2 feet of additional tubing for use during calibration, reference manual and a quick reference card.

The sample draw kit consists of a sample draw / calibration adapter, squeeze bulb, sample probe, replacement sample probe filters, and ten feet of hose.

1.3.1. "Alkaline" PhD Lite detectors

If the PhD Lite has been purchased as an "alkaline"

instrument the standard accessories also include a set of 3 disposable AA alkaline batteries.

1.3.2. "NiMH" PhD Lite detectors

If the PhD Lite has been purchased as a "NiMH" instrument the standard accessories additionally include a slip in PhD Lite fast charger.

1.4. PhD Lite kits

PhD Lite detectors may also be purchased as part of complete kits.

1.4.1. PhD Lite Confined Space Kits

Besides the standard accessories included with every PhD Lite, Confined Space Kits also include calibration fittings, regulator, one cylinder of each of the appropriate calibration gases and foam lined waterproof carrying case for the instrument, calibration materials and other accessories.

1.4.2. PhD Lite Value Pack

It is also possible to order the PhD Lite configured as a "Value Pack". The Value Pack consists the PhD Lite, all standard accessories, economy sized cylinder of all-in-one calibration gas, fixed flow rate regulator, and foam lined carrying case.

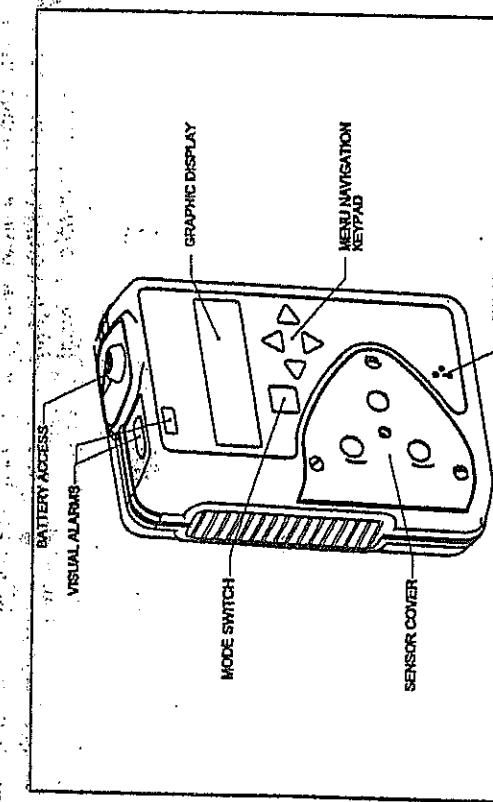


Figure 1.2. Major PhD Lite Features (Top and Front Surfaces)

Chapter 2. Basic operation

This chapter will cover how to use the PhD Lite for safe work in potentially hazardous atmospheres.

2.1. Overview of PhD Lite operation

The PhD Lite offers a choice of three modes of operation, "Text Only", "Basic", and "Technician". Which mode is selected is a function of how much information is required, the skill level of the user, and the nature of the job.

the area is once again safe for entry.

2. Warning: Use only Duracell MN1500 or Ultra MX1500, Energizer EG1-LR6, Eveready EN91 (not DEMKO approved), Radio Shack 23-874 (not DEMKO approved) size AA, 1.5V Alkaline batteries, Eveready CH15 (not DEMKO approved) or Radio Shack 23-149 (not DEMKO approved) size AA 1.2V NiCad batteries, or Eveready L91 size AA 1.5V Lithium batteries (not CSA or DEMKO approved). Substitution of batteries may impair intrinsic safety.
3. Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.
4. Caution: Accuracy of the PhD Lite must be checked with known concentration calibration gas before each day's use.
5. Caution: Use of non-standard calibration materials may lead to dangerous error as well as voiding Biosystems standard warranty for gas detection products.
6. Caution: The accuracy of the PhD Lite should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.

2.1.1. Operational warnings and cautions

1. Caution: The PhD Lite personal, portable gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicating the presence of a potentially life threatening hazard should be taken very seriously. In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and return only after further testing together with other appropriate safety procedures determine that

7. Warning: A sensor which cannot be calibrated or which is found to be out of tolerance should be replaced immediately. An instrument which fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.

8. Warning: Do not reset the calibration gas concentration unless you are using a calibration gas concentration which differs from that normally supplied by Biosystems for use in calibrating your instrument.

Customers are strongly urged to use only Biosystems calibration materials when calibrating their PhD Lite.

10. Warning: If a new sensor type is selected verify that it has been properly installed. The new sensor must be calibrated before use.

2.1.2. Turning the PhD Lite on

The large rectangular push-button on the front of the PhD Lite case is called the "mode" button. It is used to turn the PhD Lite on and off, as well as to control most other operations of the instrument. Pushing the mode button once turns the PhD Lite on.

2.1.3. Start-up sequence

After the detector has been turned on, it will automatically go through an electronic self-test and start up sequence that takes approximately twenty seconds. During the self-test sequence, the meter display back-light will momentarily turn on, the visual LED alarm light will flash, and the audible alarm will sound. The PhD Lite will also determine which "Smart Sensors" are currently installed, and whether there have been any changes since the last time the instrument was used.

9. Warning: Use of non-standard calibration gas and / or calibration kit components when calibrating your PhD Lite can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy PhD Lite calibration.

During the self-test the audible alarm will sound and the LED alarm light will be briefly activated.

Performing Self Test

During start-up the LCD display will display several messages or "screens" in sequence. The first screen displays the software version number.

biosystems
PhD Lite V1.18

Screens will indicate the battery voltage and temperature in both Centigrade and Fahrenheit.

Battery = 3.5V
Temp = 78°F

During the start-up and self-test procedure the PhD Lite automatically evaluates itself to determine its electronic fitness for use.

Several screens will be shown as the instrument loads and evaluates information from the "Smart Sensors" which are currently installed.

Loading Sensors
O2 LEL

Loading Sensors
O2 LEL

Loading Sensors
O2 LEL

The temperature displayed is not necessarily the temperature of the ambient air which surrounds the instrument. The temperature shown is actually a reading taken on the inside of the instrument case in the area where the sensors are located. This information is used by the PhD Lite microprocessor to properly adjust the sensor output when the instrument is used in changing temperatures.

The instrument will also display the alarm set-points of the sensors currently installed.

CURRENT ALARM LEVELS

LOW ALARM LEVEL
O2 = 19.5%

HIGH ALARM LEVEL
O₂ = 22.0%

If the instrument is operated in the "Text Only" mode an "OK" message will be displayed as long as measured concentrations are below the alarm set points. If readings exceed a pre-set alarm level, the message changes from "OK" to a numerical reading, the LED alarm light flashes, and the audible alarm sounds.

Note: PhD Lite gas reading alarms are user adjustable and may be set anywhere within the range of the sensor channel. In many cases it is possible to comply with OSHA guidelines while using higher alarm points than the "default" factory alarm settings. Factory default settings may be easily restored at any time. The procedure for changing or restoring default alarm settings is discussed in Chapter 4.

The final screen in the self-test and start-up sequence is the current gas level screen. This screen shows the kind of sensors currently installed and the current readings.

O₂ LEL CO H₂S
20.9 0 0 0

When the instrument is operated in either the "Basic" or "Technician" mode, numerical readings are shown.

O₂ LEL CO H₂S
OK OK OK OK

If the instrument is operated in the "Text Only" mode an "OK" message will be displayed as long as measured concentrations are below the alarm set points. If readings exceed a pre-set alarm level, the message changes from "OK" to a numerical reading, the LED alarm light flashes, and the audible alarm sounds.

2.1.4. Other start-up screens

Several additional screens may be shown under some circumstances. Usually the screen message is self explanatory.

2.1.4.1. "Non-standard alarms"

If the instrument determines that dangerously non-standard "custom" oxygen or LEL combustible gas alarms have been selected, the LCD will display the message "Non-Standard Alarms" at start-up. The LCD will display the alarm settings for the affected sensors.

WARNING: Alarms Non- Standard



O₂ Low = OFF
Mode= Acknowledge

Press the mode button to use the non-standard settings.

Note: Factory default settings may be easily restored at any time. The procedure for restoring factory default alarm settings is discussed in Chapter 4.

2.1.4.2. "Needs Cal"

Biosystems EEPROM equipped "smart" sensors automatically identify themselves to the PhD Lite in which they are installed. The PhD Lite is aware any time sensors are added, deleted, changed or replaced. Any time a change is made to the sensors installed, the PhD Lite will display the message "Needs Cal" followed by a list of the affected sensors. This is an indication that the accuracy of the affected sensors should be verified by exposure to known concentration test gas before further use.

Caution: The PhD Lite should not be put back into service or used until the accuracy of any affected sensor has been verified by exposure to the appropriate known concentration test gas.

The "Needs Cal" warning message may be acknowledged

(and silenced) by pressing the mode button.

2.1.5. Turning the PhD Lite off

Holding the mode button down for three seconds turns the instrument off. In order to prevent accidental shut downs, the mode button must be depressed for a full three seconds in order to turn the instrument off. After three seconds (marked by three beeps of the audible alarm) the LCD display will display the message "Begin SHUT DOWN Please wait". The shut-down sequence is complete when the meter display blanks out in about ten seconds.

**Begin SHUTDOWN
Please Wait**

2.2. Operating modes

The PhD Lite offers a choice of three modes of operation, "Text Only", "Basic", and "Technician". Which mode is selected is a function of how much information is required, the skill level of the user, and the nature of the job.

No matter which mode is selected, anytime the PhD Lite is on it is remembering the peak readings of all gases measured, and is calculating both Time Weighted Averages and Short

Term Exposure Levels for any toxic gas sensors installed. No matter what mode of operation is selected the PhD Lite will go into alarm whenever any alarm set-point is exceeded.

2.2.1. Text Only mode

The simplest mode of operation is the "Text Only" mode. In this mode, during normal operation, the LCD screen does not display numerical readings, only the indication 'OK'.

O2 LEL CO H2S
OK OK OK OK

If an alarm condition occurs the indication changes from "OK" to the numerical value, the LED alarm light flashes, and the audible alarm sounds.

O2 LEL CO H2S
19.1 OK OK OK

PhD Lite alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, the screen reverts back to the "OK" indication, and visual and audible alarms cease.

In the Text Only mode, only one push-button is used to turn the instrument on and off, and to switch screens. Pressing the "mode" button allows the user to toggle between available meter

display "screens". Two screens are available to the user in the "Text Only" mode. The first screen is the gas level display discussed above. Pressing the mode button displays the second screen, which shows battery voltage, running time for the instrument since last turned on (in hours and minutes), and temperature (in both Fahrenheit and Centigrade).

Runtime = 12:45
4.6V 78°F MENU

Pressing the mode button again toggles the display back to the first screen showing current gas levels.

Note: It is not possible to initiate the "Auto-Calibration" procedure while the PhD Lite is operated in the Text Only mode. The PhD Lite must be operated in either the Basic or the Technician mode in order to initiate the "Auto-Calibration" sequence.

PhD Lite alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, visual and audible alarms cease, and normal operation of the instrument resumes. Pressing the mode button allows the user to toggle between available meter display screens.

Two screens are available to the user in the Basic mode. The first screen is the gas level display discussed above. Pressing the mode button displays the second screen, which shows battery voltage, running time for the instrument since last turned on (in hours and minutes), and temperature (in both Fahrenheit and Centigrade).

Runtime = 12:45
4.6V 78°F MENU

Pressing the mode button again toggles the display back to the first screen showing current gas levels.

2.2.3. Technician mode

The "Technician Mode" provides access to all advanced functions and displays, including Auto-Calibration.

2.2.2. Basic mode

The "Basic" mode of operation is designed for users with a higher level of understanding, and a need for numerical readings, but who are not experts in gas detection.

The major difference between the Text Only and Basic operating modes is that in the Basic mode numerical gas level readings are provided, whereas in the Text Only mode only an indication that conditions are "OK" is provided during normal operation. Another important difference is that it is possible to enter the "Auto-Calibration" mode in order to make zero and span calibration adjustments while in the Basic mode. This feature is not enabled when the instrument is operated in the Text Only mode. (Calibration procedures are discussed in detail in Chapter 3.)

Basic mode current gas level screen:

O2 LEL CO H2S
20.9 0 0 0

If an alarm condition occurs, that is, when one of the sensor readings exceeds a pre-set alarm level, the numerical reading changes to reflect the new value, the LED alarm light flashes, and the audible alarm sounds.

Pressing the mode button once displays the "Peak" readings for oxygen. These readings represent the highest and lowest values registered by the instrument during any period of operation. Peak readings are updated on a second by second basis.

PEAK	LOW	HIGH
O2	17.3	20.9

Pressing the mode button again displays the "Peak" readings for any other gases being measured. These readings represent the highest values registered by the instrument during any period of operation.

PEAK	LEL	CO	H2S
O2	0	0	0

PhD Lite alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, visual and audible alarms cease, and normal operation of the instrument resumes.

Pressing the mode button allows the user to toggle between available meter display screens. Several additional screens are available to the user in the Technician mode.

The STEL (Short Term Exposure Limit) for a particular toxic gas is the maximum average concentration to which an unprotected worker may be exposed in any 15 minute interval during the day. The STEL value displayed by the PhD Lite is the average concentration

Calibration procedures are discussed in detail in Chapter 3.

After the completion of the start-up and self-test sequence, the meter display will show numeric readings of the gases being measured.

O2	LEL	CO	H2S
20.9	0	0	0

If an alarm condition occurs the numerical reading changes to reflect the new value, the LED alarm light flashes, and the audible alarm sounds.

O2	LEL	CO	H2S
19.1	0	0	0

for the most recently completed 15 minutes of operation.

STEL	CO	H2S
0	0	0

Note: For the first 15 minutes after the PhD Lite is initially turned on the STEL reading is a projected value. The PhD Lite will begin projecting a STEL value after the first 30 seconds of operation. For the first 30 seconds the STEL screen will show an "X" where the reading should be.

STEL	CO	H2S
X		

2.2.3.4. Average readings

Note: After 30 minutes the screen will also begin to indicate how long the instrument has been on. This "run time" indication will be given in hours and completed 15 minute intervals.

TWA	CO	H2S
1	HR	0

Pressing the mode button again after viewing the TWA reading as described in section 2.2.3.3, displays the Average exposure levels. The Average readings are not projected values. They are the simple arithmetic average values registered by the instrument during any period of operation.

AVERAGE	O2	LEL
20.9	0	0

Pressing the mode button again after viewing the STEL reading as described in section 2.2.3.3, displays the STEL alarm set-point. The STEL reading is constantly updated. Audible and visual gas alarms will be activated immediately any time the most recent 15 minute average exceeds the STEL alarm set-point.

Appendix A discusses Permissible Exposure Limit alarm calculations in greater detail.

2.2.3.5. TWA readings

Pressing the mode button again after viewing the STEL readings as described in section 2.2.3.2, displays TWA (Time Weighted Average) exposure levels. TWA values are calculated by projecting exposures over an eight hour period. It is not

possible to compute a toxic gas TWA until the PhD Lite has been monitoring for at least 15 minutes. Until the minimum monitoring time has elapsed, the TWA screen will show an "X" where the reading should be.

Note: After 30 minutes the screen will also begin to indicate how long the instrument has been on. This "run time" indication will be given in hours and completed 15 minute intervals.

TWA	CO	H2S
1	HR	0

2.2.3.6. Average readings

Pressing the mode button again after viewing the TWA reading as described in section 2.2.3.3, displays the Average exposure levels. The Average readings are not projected values. They are the simple arithmetic average values registered by the instrument during any period of operation.

AVERAGE	O2	LEL
20.9	0	0

Pressing the mode button again after viewing the Average exposure levels of any other gases being measured.

AVERAGE	CO	H2S
0	0	0

2.2.4. Changing operating modes

It is easily possible to shift from one operating mode to another while the instrument is in use without the loss of data. It is not necessary to turn the instrument off before switching. Simply press the mode button until the menu screen is displayed.

Runtime = 12:45
4.6V 78°F MENU

Hold the left navigation button down for 3 seconds until the cursor moves to "EXIT" which will be displayed just above the word "MENU".

Runtime = 12:45
4.6V 78°F EXIT

Press the down navigation button to highlight the word "MENU" and then press the mode button.

Runtime = 12:45
4.6V 78°F EXIT

Note: Shifting modes or otherwise reprogramming the instrument should only be done by employees who are authorized to do so.

ALARMS CALIBRATION
DETERNS SCREEN
VIEW EXIT

selection and press the mode button.

USER MODE SEC/DEEP
PASSCODE LANGUAGE
DECIMAL T/UNITS
EXIT

Using the up or down navigation buttons you can now scroll the Operating Mode types.

Operating Mode
Technician EXIT

Operating Mode
Basic EXIT

Operating Mode
Text Only EXIT

Press the mode button to select the displayed Operating Mode.

Save Changes?
YES NO CANCEL

2.3. Batteries

2.3.1. Alkaline batteries

The PhD Lite with alkaline batteries is designed to provide up to 12 hours of continuous use with each set of 3 AA disposable alkaline batteries. Access to the alkaline batteries is via the slotted screw and battery compartment cover located on the top surface of the instrument housing.

Make sure that replacement batteries are properly aligned in the battery housing before returning the instrument to service. Do not over tighten the battery compartment screw when replacing the battery cover.

Use only Duracell MN1500 or Ultra MX1500, Energizer E91-L96, Eveready EN91 (not DEMKO approved), Radio Shack 23-874 (not DEMKO approved) size AA, 1.5V Alkaline batteries, Eveready CH15 (not DEMKO approved) or Radio Shack 23-149 (not DEMKO approved) size AA 1.2V NiCad batteries, or Eveready L91 size AA 1.5V Lithium batteries (not CSA or DEMKO approved).

Substitution of batteries may impair intrinsic safety.
Note: The PhD Lite is designed to turn itself on whenever the batteries are removed then replaced. This is to insure that in the event of

an interruption in power the instrument is not accidentally turned off. Any time the batteries are momentarily removed or replaced it will be necessary to manually turn the PhD Lite off if the instrument is not going to be put to immediate use.

2.3.2. NiMH rechargeable battery

The PhD Lite equipped with a rechargeable NiMH (nickel metal hydride) battery is designed to provide up to 12 hours of continuous use. The NiMH battery is sealed in the PhD Lite and should not be disassembled in the field.

Warning: The PhD Lite may not be located in a hazardous location while being recharged.

2.3.2.1. Charging procedure with NiMH battery installed

(1) Check that the instrument is turned off. (If it is not, press the mode button until the message "Release button".)

(2) Connect the charger cradle to the 110 VAC "wall cube" power source.

(3) Plug the "wall cube" in and check to see that the "PWR" (power-on) indicator LED on the charger cradle is lit.

- (4) Slip the PhD Lite into the charger cradle and check to see that the "FAST" (fast charger) indicator LED on the charger cradle is lit. **Note: The "FAST" Indicator will initially light up and remain lit for the first 15 minutes no matter what the battery pack voltage.**

- (5) When charging is complete the "FAST" indicator will turn off. Charging is complete any time after the "TRIC" (trickle charge) indicator is lit.

2.3.3. Low battery alarms

Alarms will be activated whenever battery voltage is too low to allow the safe operation of the instrument.

Battery voltage may be checked at any time while the instrument is in normal operation using the mode button to show the instrument status screen.

Alarms will be activated whenever battery voltage is too low to allow the safe operation of the instrument. When the battery voltage is reduced to approximately 3.3 Volts, an audible alarm sounds, and the display screen indicates a low battery condition exists. At this stage, the low battery alarms may be silenced for a fifteen-minute period by pressing the Mode button. The alarm will continue to sound every fifteen

minutes until the voltage drops to the "Very Low Battery" level.

When battery voltage has reached the "Very Low Battery" level it is no longer safe to continue to use the instrument with the current set of batteries. It is no longer possible to silence the low battery alarms and it is necessary to leave any hazardous area in which the instrument is being used immediately.

When the voltage drops further the PhD Lite will display a "Dead Batt" message to warn the user of imminent shut down. The instrument will then automatically turn itself off.

After any low battery alarm the batteries should be replaced if the PhD Lite is equipped with alkaline batteries or the battery should be recharged if the PhD Lite is equipped with a NiMH rechargeable battery.

Use only Duracell MN1500 or Ultra MX1500, Energizer E91-LR6, Eveready EN91 (not DEMKO approved), Radio Shack 23-149 (not DEMKO approved) size AA, 1.5V Alkaline batteries, Eveready CH15 (not DEMKO approved) or Radio Shack 23-149 (not DEMKO approved) size AA 1.2V NiCad batteries, or Eveready L91 size AA 1.5V Lithium batteries (not CSA or DEMKO approved).

Substitution of batteries may impair intrinsic safety.

2.4. Methods of sampling

2.4.1. Using the hand aspirated sample draw kit

- (1) Connect the sample draw / calibration adapter with the squeeze bulb and hose assembly. Connect the end of the hose closest to the bulb to the sample draw adapter. Connect the other end of the hose to the sample probe as shown in Figure 2.4.1.
- (2) Attach the sample draw adapter to the PhD Lite as shown in Figure 2.4.1.1.
- (3) Cover the end of the sample draw probe assembly with a finger, and squeeze the aspirator bulb. If there are no leaks in the sample draw kit components, the bulb should stay deflated for a few seconds.
- (4) Insert the end of the sample probe into the location to be sampled.
- (5) Squeeze the aspirator bulb several times to draw air from the remote location to the sensor compartment. Allow one squeeze of the bulb for every one foot of sampling hose. Continue squeezing until the readings stabilize.
- (6) Note the gas measurement readings.



Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.

Each time a reading is desired, it is necessary to squeeze the bulb a sufficient number of times to bring a fresh sample to the sensor compartment.

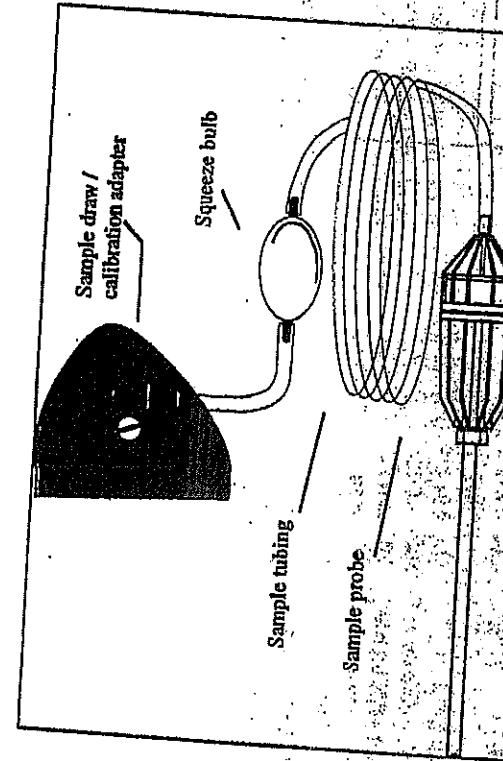


Figure 2.4.1. PhD Lite hand aspirated sample draw kit

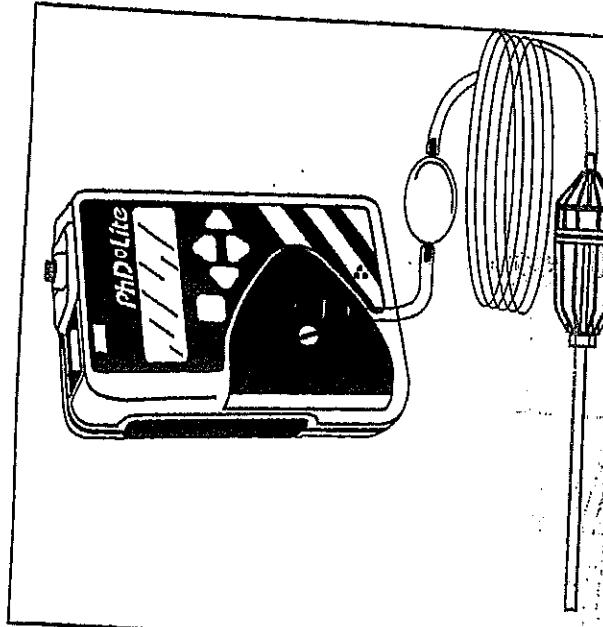


Figure 2.4.1.1. PhD Lite with hand aspirated sample draw kit attached.

2.4.2. Continuous (slip-on) sample draw pump

Use of the slip-on sample draw pump allows the PhD Lite to continuously monitor locations which are remote from the instrument. The pump obtains power directly from the PhD Lite battery. An animated "P" icon located in the upper left hand corner of the LCD display indicates that the pump is attached and in normal operation.

Warning: Never operate the sample draw pump unless the hose and probe assembly is attached. The sample probe handle contains replaceable filters designed to block moisture and remove particulate contaminants. If the pump is operated without the probe assembly in place particulate contaminants may cause damage to the pump.

The sample draw pump includes a unique pressure sensor designed to protect the PhD Lite from exposure to water or other liquids. If there is a change in

⊗ O ₂	LEL	C _O	H ₂ S
20.9	0	0	0

- pressure in the sample draw assembly due to fluid intake, the pump immediately shuts down. After a few seconds audible and visual alarms indicating a low flow condition will also be activated.
- Note:** Make sure that the sample draw tube is not inserted into a fluid horizontally or at a low angle.

The pressure sensor in the sample draw pump is designed to detect changes while the sample draw probe is being held in a vertical position. If the probe is held horizontally or at a low angle when inserted into a fluid, a pressure drop sufficient to cause the pump to shut down may not be generated, and water could be drawn into the pump assembly.

To avoid potential damage, care must be taken to keep the probe vertical any time fluids might be present.

- #### 2.4.2.1. Using the continuous sample draw pump
- (1) Connect the slip-on battery operated pump with the hose and probe assembly as shown in **Figure 2.4.2.1.**
 - (2) Slip the pump onto the PhD Lite as shown in **Figure 2.4.2.1.1.**

- (3) Make sure the pump is securely attached by the captive screw.
- (4) Turn on the PhD Lite. The pump will be activated automatically when properly attached to the PhD Lite.

Pump Detected

- (5) When prompted cover the end of the sample draw probe assembly with a finger. If there are no leaks in the sample draw kit components, a message will be displayed indicating that the pump test passed.

Pump Testing Block Sample

- To avoid potential damage, care must be taken to keep the probe vertical any time fluids might be present.

2.4.2.2. Protective "low flow" shut-downs

- If a protective pump shut-down occurs, the following steps should be taken before the instrument is put back into use:

- (1) Turn off the PhD Lite detector and disconnect the sample draw pump.
- (2) Remove the sample draw assembly from the area being monitored. Be careful to keep the sample draw probe in a vertical position.

Pump Test Passed Press Mode

- (6) Insert the end of the sample probe into the location to be sampled.
- (7) Wait long enough for the pump to have drawn the sample through the entire length of hose, and for the sensors to have

- (8) Note gas measurement readings

2.4.2.3. Resuming diffusion monitoring

In order to stop using the pump and resume diffusion monitoring, simply disconnect the pump assembly from the PhD Lite. The audible and visual alarms will be activated and the LCD will display the message "Pump Disconnect". Press mode to acknowledge and resume normal diffusion operation.

Pump Disconnect

- (3) Examine the sample draw probe and hose to make sure no fluids remain trapped.
- (4) Allow any trapped fluids to completely drain. (It may be necessary to disconnect the hose or sample draw probe before drainage can occur.)
- (5) Replace the sample draw probe filters if necessary.

and slide the bowl back into place in the probe handle. The hydrophobic barrier filter fits into a socket in the rear section of the probe handle. (The narrow end of the hydrophobic barrier filter is inserted towards the rear of the handle.)

2.4.3. Sample probe assembly

The sample probe handle contains moisture barrier and particulate filters designed to remove contaminants which might otherwise harm the instrument. Never use the sample draw kit unless the probe assembly is attached to the sample tubing!

Particulate contaminants are removed by means of a cellulose filter similar to those used in filter cigarettes. The hydrophobic filter includes a 0.1 µm Teflon™ barrier which blocks the flow of moisture as well as any remaining particulate contaminants.

Sample probe filters should be replaced whenever visibly discolored due to contamination. A spare filter (replacement kit (part number 54-05-K040) is included with every PhD Lite.

The standard 11.57 long butylate probe tube is held in place by means of a hex-nut compression fitting and compression sleeve. The standard probe tube is designed to be easily interchangeable with other custom length sections of 1/4" OD tubing, or probe tubes made of other materials (such as stainless steel).

Probe tubes are exchanged by loosening the hex-nut compression fitting, removing the old tube, sliding the compression sleeve into place around the new tube, inserting the new tube into the probe handle, then replacing and tightening the hex-nut.

Note: The sample probe must be checked for leakage (as discussed in Section 2.4.1,) whenever filters or probe tubes are exchanged or replaced before being put back into service.

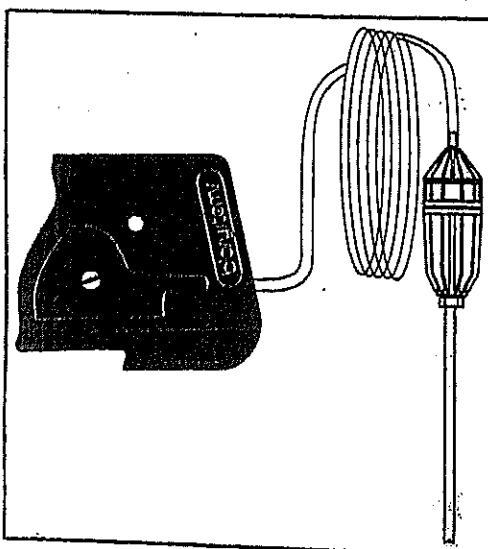


Figure 2.4.2.1. Sample draw pump and probe assembly

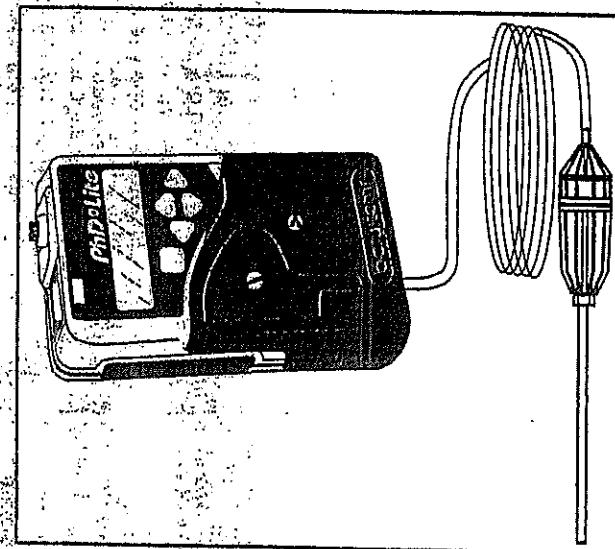


Figure 2.4.2.1.1. PhD Lite with sample drawing pump attached

all of these particulars for the sensors currently installed both when the instrument is turned on, whenever a change is made during operation, and again as the instrument is turned back off.

If a sensor is changed or replaced the PhD Lite notes that a change has occurred, displays a "Needs Cal" message the next time the instrument is turned back on, and identifies the affected sensors. Even if the change is only to replace one sensor with another of the same kind, the PhD Lite will still note the change in serial numbers of the sensors installed, and display the "Needs Cal" message.

Notes: The accuracy of any sensors which are identified as "Needing Calibration" must be verified by exposure to known concentration calibration gas before the PhD Lite is put back into service.

2.5.2. Other information stored with the sensor EEPROM

2.5. Biosystems EEPROM equipped "Smart Sensors"

Each sensor installed in a PhD Lite detector is equipped with its own non-volatile memory storage device or "EEPROM". The contents of the sensor's memory device are designed to be read and updated directly by the PhD Lite. The fact that each sensor is capable of remembering and communicating important

information about itself to the instrument allows for a number of important PhD Lite operating benefits.

2.5.1. Identification of type of sensor by instrument

Besides being identified by type of sensor, recorded sensor information also includes the sensor serial number, the most recent calibration settings, temperature compensation curves, and the most recent alarm settings. The PhD Lite automatically updates and notes

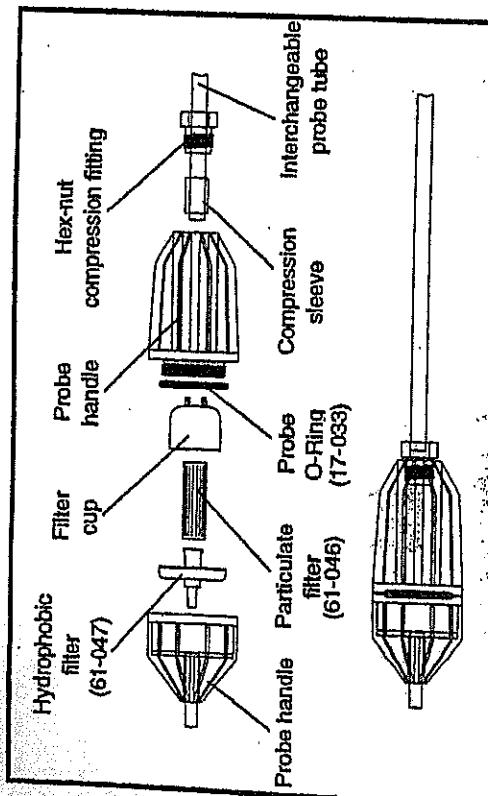


Figure 2.4.3. PhD Lite sample probe assembly

Any sensor installed in the PhD Lite automatically identifies itself to the instrument microprocessor. The PhD Lite automatically identifies the kinds of sensor installed on the liquid crystal display (LCD) and assigns the correct alarm settings.

2.5.3. Automatic sensor setup

To remove or replace sensors and automatically update the PhD Lite sensor configuration:

- (1) Make sure the PhD Lite is turned off.
- (2) Remove the sensor compartment cover.

all of these particulars for the sensors currently installed both when the instrument is turned on, whenever a change is made during operation, and again as the instrument is turned back off.

If a sensor is changed or replaced the PhD Lite notes that a change has occurred, displays a "Needs Cal" message the next time the instrument is turned back on, and identifies the affected sensors. Even if the change is only to replace one sensor with another of the same kind, the PhD Lite will still note the change in serial numbers of the sensors installed, and display the "Needs Cal" message.

Notes: The accuracy of any sensors which are identified as "Needing Calibration" must be verified by exposure to known concentration calibration gas before the PhD Lite is put back into service.

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Besides being identified by type of sensor, recorded sensor information also includes the sensor serial number, the most recent calibration settings, temperature compensation curves, and the most recent alarm settings. The PhD Lite automatically updates and notes

- (3) Identify which sensor you wish to replace.

- (4) Gently pull the sensor out of its socket.

- (5) Press the replacement sensor into place.

- (6) Replace the sensor compartment cover.

- (7) Allow at least two hours for the sensor to stabilize. (The instrument does not need to be turned on while new sensors are stabilizing.)

- (8) The PhD Lite will automatically note the changes that have been made when next turned on.

- (9) Recalibrate the new sensor before the instrument is put back into service.

Note: The first fresh air zero adjustment after installation of a new sensor should be done using the "manual" calibration procedure as discussed in Section 3.5.1. of this manual.

PhD Lite programming includes safe guards to spot misadjusted sensors. If the settings on the new sensor are significantly different from those of the old it will trigger a message that the sensor is reading "Too Low" or "Too High" for One-Button Auto-Calibration zero adjustment.

Once the new sensor has been fresh air zero adjusted using the "manual" calibration procedures it will be possible to do subsequent zero and span calibrations in the normal way by using the mode button and One-Button-Auto-Calibration procedures.

2.5.4. Missing sensor

The PhD Lite is also able to determine if a sensor is removed or becomes disconnected while the instrument is in normal operation. Removal of a sensor while the instrument is turned on will trigger a missing sensor alarm. The channel will "X" out and the audible and visual alarms for the affected sensor channel will be activated.

the instrument for those sensors which can be successfully read.

Chapter 3. Calibration

The PhD Lite detector has been designed for easy calibration. A single button, the on / off "mode" switch is used to enter the "Auto-Calibration" mode, and automatically make all calibration adjustments.

If the PhD Lite is unable to read the EEPROM of a smart sensor currently installed the channel will "X" out and the audible and visual alarms for the affected sensor channel will be activated.

2.5.5. Sensor not found

If the PhD Lite is unable to read the EEPROM of a smart sensor currently installed the channel will "X" out and the audible and visual alarms for the affected sensor channel will be activated.

If a smart sensor is removed while the instrument is turned off without being replaced with another sensor, a message will be displayed during the start-up sequence indicating that the sensor is missing. Pressing the mode button acknowledges the condition, and allows the use of

readings are within $\pm 10\%$ of the expected value for the gas being used, there is no need to adjust your gas detector. If the readings are inaccurate, the instrument should be "Span" adjusted before further use.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy PhD Lite calibration.

Warning: Use of non-standard calibration gas and/or calibration kit components when calibrating your PhD Lite can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

3.1. Verification of accuracy
Accuracy of the PhD Lite must be checked with known concentration calibration gas before each day's use.

Verification of accuracy is a two step procedure. In the first step the PhD Lite is taken to an area where the atmosphere is fresh and the readings are checked. If the readings differ from those expected in fresh air a "zero" adjustment must be made. The second step is to make sure the sensors are accurate by exposing them to known concentration test gas and noting the response. If the readings are accurate, that is, if the instrument

3.1. Effect of contaminants on PhD Lite sensors

The atmosphere in which the PhD Lite monitor is being used can have an effect on the sensors. Sensors may be poisoned or suffer degraded performance if exposed to certain substances.

There are three basic types of sensors which may be installed in the PhD Lite detector; oxygen, combustible gas (LEL), and electrochemical toxic. Each type of sensor uses a slightly different detection principle. The kinds of conditions that affect the accuracy of the sensors varies from one type of sensor to the next.



Caution: The accuracy of the PhD Lite should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.

accuracy of the PhD Lite should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.

containing substances (found in many lubricants and hydraulic fluids), the tetra-ethyl-lead in "leaded" gasoline, and halogenated hydrocarbons (Freons®, or solvents such as trichloroethylene and methylene chloride). High concentrations of hydrogen sulfide may also damage the sensor.

Note: If sensitivity of the combustible sensor is lost due to poisoning, it tends to be lost first with regards to methane.

A partially poisoned sensor might still respond accurately to propane while showing a dangerously reduced response to methane.

Biosystems' "Propane Equivalent" calibration gas mixtures have been developed to eliminate this potentially dangerous source of calibration error. Because Biosystems' "Propane Equivalent" mixtures are based on methane, any loss of sensitivity to methane is detected (and can be corrected) immediately.

Oxygen sensors may be affected by prolonged exposure to "acid" gases such as carbon dioxide. The oxygen sensors used in Biosystems instruments are not recommended for continuous use in atmospheres which contain more than 25 % CO₂.

Using Biosystems brand calibration gas and verifying accuracy before each day's use insures that proper sensitivity is maintained over the life of the sensor.

Combustible sensors may be affected by exposure to silicone

3.1.1.2.1. Effects of high concentrations of combustible gas on the combustible sensor

The accuracy of combustible sensors may also be affected by exposure to high concentrations of combustible gas. To minimize the chance for damage or loss of sensitivity to the combustible sensor, the PhD Lite is designed to "alarm latch" whenever the concentration of combustible gas exceeds 100 percent LEL. Under these conditions the combustible gas reading will show an "X" to indicate an over-limit condition. The current gas reading display will alternate (toggle) with a screen showing the message "LEL-OVERRANGE". The audible and visual alarms will sound continuously until the instrument is manually reset by turning it off, then turning the instrument back-on in an area where the air is known to be fresh.

Caution: Make sure the PhD Lite is located in fresh air before turning the instrument back on



Caution: Any rapid up-scale reading followed by a rapid declining or erratic reading may indicate a gas concentration beyond the upper scale limit which may be hazardous.

3.1.1.3. Effects of contaminants on toxic gas sensors

Biosystems' "substance-specific" electrochemical "smart" sensors are used to measure CO, H₂S, PH₃, SO₂, NH₃, CL₂, CLO₂, HCN, NO, and NO₂ have been

carefully designed to minimize the effects of common interfering gases. "Substance-specific" sensors are designed to respond only to the gases they are supposed to measure. The higher the specificity of the sensor the less likely the sensor will be affected by exposure to other gases which may be incidentally present. For instance, a "substance-specific"

concentration test gas before further use.

Note: The combustible sensor used in the PhD Lite design requires the presence of oxygen in order to detect combustible gas. The accuracy of the combustible instrument is used in oxygen deficient atmospheres.

carbon monoxide sensor is deliberately designed not to respond to other gases which may be present at the same time, such as hydrogen sulfide or methane.

Even though care has been taken to reduce cross-sensitivity, some interfering gases may still have an effect on toxic sensor readings. In some cases the interfering effect may be "positive" and result in readings which are higher than actual. In some cases the interference may be negative and produce readings which are lower than actual.

3.1.1.5. Biosystems "CO Plus" dual purpose carbon monoxide / hydrogen sulfide sensor

In addition to "substance specific" sensors designed to measure carbon monoxide and hydrogen sulfide, Biosystems also offers a dual purpose sensor designed to detect both carbon monoxide and hydrogen sulfide. The "CO Plus" sensor is ideal for situations requiring use of a single sensor to monitor simultaneously for both toxic hazards.

The "CO Plus" sensor has been designed to respond to both carbon monoxide and hydrogen sulfide, and can be calibrated for the direct detection of either hazard. Since the sensor has been designed to respond to both hazards at once, it cannot discriminate between or tell which of the two gases is producing the reading. It can't tell which hazard is present in what specific concentrations, but will give an immediate indication whenever conditions become unsafe.

When a specific contaminant such as hydrogen sulfide is known to be potentially present the best approach is usually to use a direct reading substance specific sensor. The OSHA standard for permit required confined space entry (29 CFR 1910.146) explicitly requires the use of direct reading, substance

readings may be dangerously low.

Biosystems multi-component calibration gas mixtures which contain both carbon monoxide and hydrogen sulfide are labeled as "Not for use with CO Plus sensors".

Caution: The gas that is chosen must be the gas that is actually used during calibration.



If carbon monoxide is chosen carbon monoxide must be used. Likewise if hydrogen sulfide is chosen hydrogen sulfide must be the gas actually used to verify accuracy. Use of the incorrect calibration gas may lead to incorrect readings.

Caution: Do not use multi-component calibration gas mixtures which



contain both carbon monoxide and hydrogen sulfide when calibrating instruments with "CO Plus" sensors installed.

Biosystems "CO Plus" sensors are designed for the simultaneous detection of both carbon monoxide and hydrogen sulfide. "CO Plus" sensors may be calibrated to either carbon monoxide or hydrogen sulfide. The calibration gas used to calibrate "CO Plus" sensors may contain only one or the other of these two gases. If a "CO Plus" sensor is calibrated with a mixture that contains both carbon monoxide and hydrogen sulfide

calibration gas mixtures which contain both carbon monoxide and hydrogen sulfide are labeled as "Not for use with CO Plus sensors".

Caution: The gas that is chosen must be the gas that is actually used during calibration.



If the sensor is calibrated to carbon monoxide the current gas reading display will identify a "CO+" sensor as being currently installed and the PhD Lite will automatically use the alarm settings for carbon monoxide. If hydrogen sulfide is chosen as the calibration gas the display will identify the sensor installed as an "H₂S+" sensor and H₂S alarm settings will automatically be used.

3.1.15.1. Relative response of the "CO Plus" sensor to carbon monoxide and hydrogen sulfide

A properly calibrated "CO Plus" sensor will be exactly accurate for the gas to which it is calibrated. OSHA has assigned an 8 hour TWA of 35 ppm as the permissible exposure limit for carbon monoxide. If the "CO Plus" sensor is calibrated to carbon monoxide then exposed to 35 ppm carbon monoxide the reading will be .35 ppm.

The "CO Plus" sensor will also show a "relative response" to other interfering gases. When calibrated on carbon monoxide the relative response of the "CO Plus" sensor to hydrogen sulfide is a ratio of about 3.5 to 1.0. This means a concentration of about 10 ppm hydrogen sulfide would produce a "CO+" sensor reading of 10×3.5 or 35 ppm.

This is a very convenient relative response. The 8 hour TWA permissible exposure limit for hydrogen sulfide is 10 ppm. This means that the "CO+" gas alarms will be tripped any time the concentration of hydrogen sulfide exceeds the permissible exposure limit.

3.2. Fresh air "zero" calibration

The fresh air "zero" must be done in fresh, uncontaminated air. In this procedure the instrument automatically adjusts its oxygen, combustible gas, and toxic gas readings to match the concentrations present in fresh air (20.9 percent O₂, 0.0 percent LEL, 0.0 PPM toxic gas).

Since fresh air contains 20.9 percent oxygen, this is the only calibration needed for the oxygen sensor. Toxic and combustible gas sensors must also undergo span calibration to insure accuracy.

3.3. Functional (bump) test

A simple functional (bump) test is all that is needed to verify accuracy.

To perform a functional (bump) test, turn the PhD Lite on, and wait at least three minutes to allow the readings to fully stabilize. Make sure the instrument is located in fresh air. Check to see that the readings match the concentrations present in fresh air. If the PhD Lite is operated in either the Basic or Technician operating mode the fresh air readings should equal

20.9 % O₂, 0 % LEI, and 0 ppm for any toxic sensors installed. If the instrument is operated in the Text Only mode all readings should indicate conditions are "OK". If necessary, fresh air zero the instrument using the procedures discussed in **Section 3.4.1.**

Attach the calibration adapter as discussed in **Section 3.4.2** and flow calibration gas to the sensors. (All-in-one-calibration mixtures are particularly useful in functional test procedures.) Wait for the readings to stabilize. (Forty-five seconds to one minute is usually sufficient.) Note the readings. If the readings are accurate it is safe to use the instrument without further adjustment.

Readings which are more than 10 percent higher or any amount lower than expected indicate the instrument must be adjusted using the "span" calibration procedures discussed in **Section 3.4.2** before further use.

3.4. Auto-calibration

Biosystems one-button "Auto-Calibration" mode may be used to verify accuracy any time during normal operation.

Pressing the mode button three times in rapid sequence places the instrument in the "Auto-Calibration" mode.

Adjustments are made automatically simply by pressing the mode button.

Auto-calibration is a two step procedure. In the first step the PhD Lite is taken to an area where the atmosphere is fresh and a "zero" adjustment is made automatically by pressing the mode button. The second step is the sensor response or "span" calibration adjustment. In this step the accuracy of the PhD Lite sensors is established by exposing them to known concentration calibration gas. Once again, the sensitivity or "span" is automatically adjusted by pressing the mode button.

3.4.1. Fresh air "zero" auto-calibration sequence

The fresh air zero procedure may only be done while the instrument is being operated in either the Technician or Basic operating mode.

(1) Turn the instrument on and make sure gas readings are given in numbers.

If readings are given in the form of "OK" text messages the instrument is currently being operated in the "Text Only" mode. It will be necessary to change to either the Basic or Technician operating mode

as explained in section 2.2.4. Switch modes (if necessary) by choosing "Options" from the main menu screen, then "User Mode" from the options menu. Use the navigation buttons to select the desired operating mode. When the desired mode has been selected, press mode. Each time the operating mode is changed, the LCD screen will briefly indicate the current operating mode.

- (2) Wait at least three minutes after turning the instrument on to allow sensor readings to stabilize fully before initiating auto-calibration procedures.

- (3) Make sure the instrument is located in an area where the air is known to be fresh.
- (4) Press the mode button three times within two seconds. This will "wake up" the instrument from normal operation, and put it into the "Auto-Calibration" mode. A screen will briefly display the message "One button Auto-Calibration". This screen will be followed by the "Zero Calibration Adjustment" screen.

- (6) If the mode button is not pushed within five seconds a fresh air zero adjustment will not be made. A message screen indicating that the zero values have not been changed will be briefly displayed, and the instrument will be returned to normal operation.

Zero Calibration
Mode = Adjust 5

This screen also includes a timer which counts down the number of seconds which remain in which to choose to make the adjustment.

- (5) Pressing the mode button within five seconds causes the fresh air adjustment to be made. An information screen is briefly displayed while the adjustments are being made, and another when the adjustments have been completed.

Zero Calibration
Please Wait.

Zero Calibration
Completed

Zero Calibration
Unchanged

3.4.1.1. Reading "Too High" or "Too Low" for zero adjust

To reduce the chances of the PhD Lite being inadvertently zeroed in contaminated air, only small adjustments are allowed through the use of the "One Button" auto-zero sequence. If the necessary adjustments are too large the display will indicate the sensor (or sensors) affected, and a message screen will indicate that the reading is "Too Low" or "Too High" for zero adjustment. In this case the instrument must be fresh air zeroed using the manual calibration procedures as discussed in Section 3.5.1. of this manual.

Once the instrument has been successfully zeroed using the "manual" procedures, subsequent calibration adjustments may be made using the mode button and "One Button Auto Calibration" logic discussed in this section.

3.4.2. "Span" auto-calibration sequence

After successful completion of the "zero" auto-calibration adjustment the display will show

the "Span Calibration Adjustment" screen.

Span Calibration Mode
= Adjust 5

This screen also includes a timer which counts down the number of seconds which remain in which to choose to make the adjustment.

If the mode button is not pushed within five seconds a span calibration adjustment will not be made. A message screen indicating that the span values have not been changed will be briefly displayed, and the instrument will be returned to normal operation.

Span Calibration
Unchanged

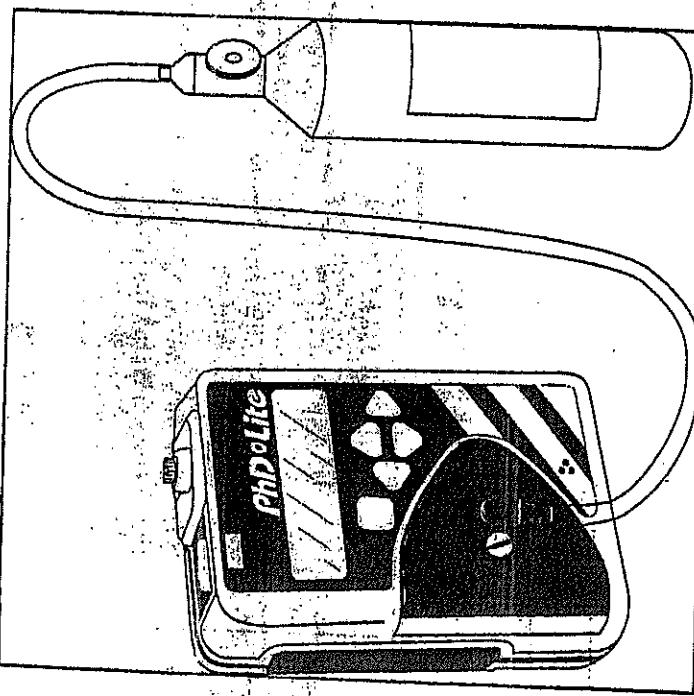
(1) Press the mode button within 5 seconds to initiate "span" auto-calibration. A screen will ask you to "Apply Gas".

Apply Gas
Mode = Cancel

The instrument will continue to display this screen until it determines that calibration gas has been applied. (Auto-span may be cancelled at any time during the procedure by pressing the mode button.)

- (2) Attach the cylinder of calibration gas, regulator, short section of tubing and calibration adapter to the PhD Lite as shown in figure 3.4.2.

Note: Make sure the regulator, cylinder seating surfaces, and threads are clean and dry when attaching the regulator to the cylinder of gas.



- (3) When the instrument detects that calibration gas has begun to reach the sensors, the display will show the message "Please Wait".

- (4) If the instrument determines that the calibration gas being used is a multi-component mixture the display will show the message "Multi Cal Gas Detected".

**Multi Cal
Gas Detected**

The instrument will then show a succession of screens as each sensor that may be calibrated using the multi-component mixture is adjusted in turn. The entire span adjustment process is automatic.

**LEL Sensor
Reading 48**

**LEL Sensor
Adjusted to 50**

**CO Sensor
Reading 47**

**CO Sensor
Adjusted to 50**

- (5) As each sensor is adjusted the screen indicates the concentration and type of test gas that is being used to calibrate the sensor.
- Note: Verify that the concentration printed on the label of the calibration gas cylinder matches the concentration shown on the "Span Adjust" screen as each sensor is adjusted. If the concentration does not match it will be necessary to assign a new calibration gas concentration before continuing with the auto-span adjustment.
- Assign a new calibration gas concentration by choosing "Calibration" from the main menu screen, then "Cal Gas Value" from the calibration menu. Use the navigation buttons to select the detector channel, and to assign the desired calibration gas value. When the desired value has been entered, press mode to update the calibration gas

- (3) When the instrument detects that calibration gas has begun to reach the sensors, the display will

value used during auto calibration procedures.

Note: If single component calibration gas is used it will be necessary to change cylinders between sensor adjustments. In this case the display will indicate the kind and concentration of the next type of calibration gas which should be applied.

Apply 50ppm CO
Mode = Cancel

When the instrument has detected that the proper gas has been applied the sensor will be adjusted.

CO Sensor
Adjusted to 50

- (6) When all sensors currently installed have been successfully span adjusted the display will announce "Auto Calibration Completed". The instrument will then shut itself off.
- (7) Remove all fittings from the PhD Lite, and press the mode button to turn the instrument on and resume normal operation.
- Note:** It is possible to exit the auto-calibration mode at any time prior to completion by pressing and holding down the mode button to turn the instrument off. The instrument will retain the updated settings for those sensors for which span adjustments have been completed. Sensors which were not successfully adjusted at the time the auto-calibration sequence was terminated will trigger a "Needs Cal" message at the time the instrument is next turned on. The accuracy of those remaining sensors should be verified by exposure to known concentration test gas before the instrument is put back into service.

3.4.3. Calibration procedures for "corrosive gas" sensors

Highly reactive or "corrosive" gases such as ammonia, chlorine, hydrogen cyanide and nitrogen dioxide tend to react quickly with or be absorbed by other substances.

The calibration kits for these gases include a special single-sensor Teflon® calibration adapter, and a length of FEP (fluoro-polymer) lined tubing which is used in place of the standard tubing to connect the adapter to the cylinder of calibration gas.

Automatic span adjustment done in the same manner discussed in section 3.4, non-corrosive gases except that when prompted to "A Gas" the Teflon® adapter attached directly over the sensor opening as shown figure 3.4.3.1.

Note: Some corrosive gas sensors may take several minutes to reach their stable reading. Make sure keep the adapter in place until the LCD screen indicates that adjustment is complete.

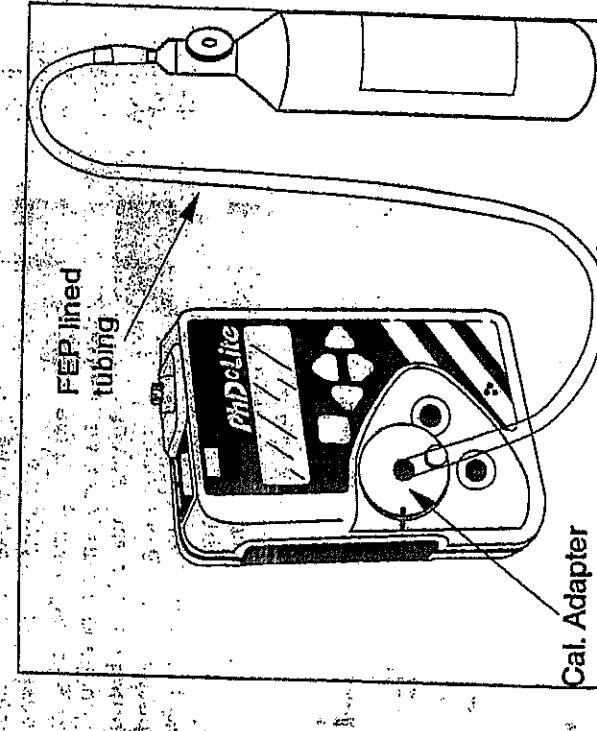
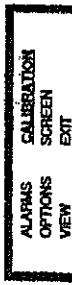


Figure 3.4.3.1. Corrosive Sensor Calibration Setup

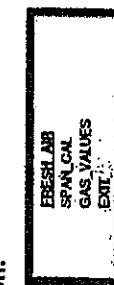
5. Manual Calibration
is possible to calibrate the pH Lite manually using the navigation buttons to select the desired calibration procedure.

- (5) Press the mode button to exit.

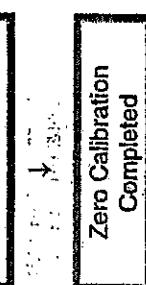
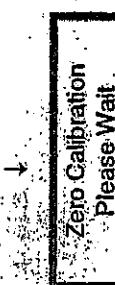
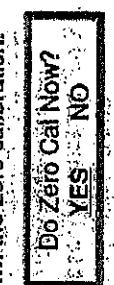
Using the navigation buttons to move to the "CALIBRATION" selection and press the mode button.



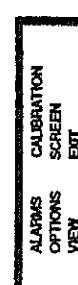
Use the navigation buttons to move to the "FRESH AIR" selection and press the mode button.



Again use the navigation buttons to select "Yes," and then press the mode button to perform the zero calibration.



(4) After completion of the zero adjustment the pH Lite automatically returns to the main menu screen display.



Runtime = 12:45 4.6V 78°F



Press the down navigation button for 3 seconds until the screen moves to "EXIT" which is displayed just above the word "MENU".



3.5.2. Alternate manual fresh air "zero" procedures

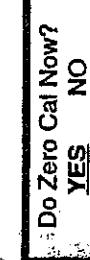
Additionally there are two other ways to manual fresh air "zero" the pH Lite. The first can be done while the instrument is already on and the second can be done when the instrument is turned on.

To fresh air "zero" the instrument when it is already in normal operation do the following:

- (1) Hold the left navigation button down for six seconds until the "Do Zero Cal Now?" screen appears.

- (2) Use the navigation buttons to select "Yes" and then press the mode button to perform the zero calibration.

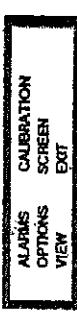
Note: If no action is taken within fifteen seconds of entering the "Do Zero Cal Now?" screen, the instrument will return to normal operation.



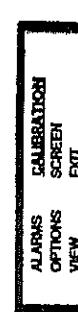
↓

To fresh air "zero" the instrument when turning on the instrument do the following:

(1) Turn on the pH Lite by holding down the left navigation button and tapping the mode button once. After the initial start up screen sequence the following screen is displayed.



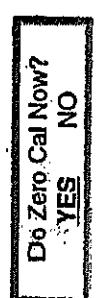
(2) Using the navigation buttons to move to the "CALIBRATION" selection and press the mode button.



- (3) Use the navigation buttons to move to the "FRESH AIR" selection and press the mode button.



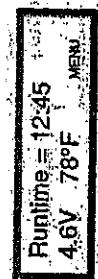
- (4) Again use the navigation buttons to select "Yes" and then press the mode button to perform the zero calibration.



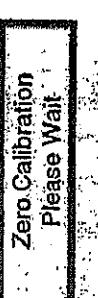
3.5.3. Manual span calibration procedures

Manual span calibration procedures are most useful when calibration of only a single sensor is desired.

- (1) Turn the instrument on.
- (2) Wait at least three minutes after turning the instrument on to allow sensor readings to stabilize fully before initiating manual span calibration procedures.
- (3) Press the mode button until the following menu screen is displayed.



- (4) Hold the left navigation button down for 3 seconds until the cursor moves to "EXIT" which will be displayed just above the word "MENU".



- (5) After completion of the zero adjustment the PhD Lite automatically returns to the main menu screen display.



- (6) Press the mode button to exit.

of gas. Introduction of contaminants through the regulator fittings may alter or degrade the concentration of the gas contained in the cylinder.

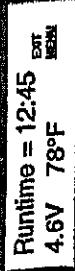
The regulator will automatically begin flowing calibration at the correct flow rate as soon as it is screwed into the cylinder of gas.

Warning: Make sure the correct cylinder of gas attached before attempting to adjust the span! Use of incorrect calibration gas may lead to incorrect readings!

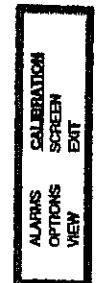
(9) When the readings stabilize, use the navigation buttons to raise or lower the reading so match the concentration printed on the calibration cylinder label.



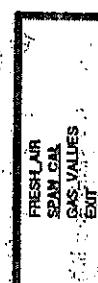
(10) When the span calibration for a particular sensor is completed, use the navigation buttons to advance to the next channel to be span adjusted.



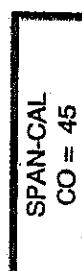
- (6) Use the navigation buttons to move to the "Calibration" selection and press the mode button.



- (7) Use the navigation buttons to move to the "SPAN CAL" selection and press the mode button.



- (8) Again use the right or left navigation buttons to select which sensor type to perform the span calibration on. Once the sensor type is selected attach the cylinder of calibration gas, regulator, short section of tubing and calibration adapter to the PhD Lite. Apply gas.



- (5) Press the down navigation button to highlight the word 'MENU' and then press the mode button.

Note: Make sure the regulator, cylinder seating surfaces, and threads are clean and dry when attaching the regulator to the cylinder

Press the mode button to exit and save the new calibration settings.

Save Cal Values?		
YES	NO	CANCEL

Take sure to remove all fittings before turning the instrument back on and turning to normal operation.

Chapter 4. PhD Lite Advanced Functions

4.1. PhD Lite Advanced features overview

PhD Lite microprocessor circuitry makes possible a number of advanced features and capabilities. The four navigation buttons located on the instrument keypad may be used change alarm set-points, change the kind or concentration of calibration gas used during auto-span calibration procedures, assign an instrument ID number, or make use of other PhD Lite optional setup choices.

calibration procedures, assign an instrument ID number, or make use of other PhD Lite optional setup choices.

Caution: Use of navigation buttons to setup or reprogram the PhD Lite is reserved for authorized personnel.

O2	LEL	CO	H2S
OK	OK	OK	OK

- (2) Press the mode button until the following menu screen is displayed.

Runtime = 12:45	4.6V	78°F	MENU
-----------------	------	------	------

- (3) Hold the left navigation button down for 3 seconds until the cursor moves to "EXIT" which will be displayed just above the word "MENU".

Runtime = 12:45	4.6V	78°F	EXIT
-----------------	------	------	------

- (4) Press the down navigation button to highlight the word "MENU" and then press the mode button.

Runtime = 12:45	4.6V	78°F	EXIT
-----------------	------	------	------

4.1.1. Instrument Setup Main Menu

To activate the instrument setup main menu perform the following steps:

- (1) Turn the instrument on and wait until gas readings are displayed.

O2	LEL	CO	H2S
20.9	0	0	0

OR

4.2. Setting alarm levels

PhD Lite gas alarms are user adjustable and may be set anywhere within the range of the sensor channel. When an alarm set point is exceeded a loud audible alarm sounds, and a

bright red LED alarm light for each affected sensor blinks.

The PhD Lite alarms are normally self resetting, which means, as soon as readings drop below the alarm set point, the alarm ceases. It is possible to set PhD Lite alarms so that they "latch". In the latched condition, once an alarm occurs both visual and audible alarms continue to sound even after the atmospheric hazard has cleared. The instrument must be manually reset by pressing the mode button. Pressing the mode button silences the alarms and restores normal operation.

Procedures for latching PhD Lite alarms are given in Section 4.2.3.

4.2.1. Alarm adjustment sequence

Note: Factory default settings can be restored at any time during normal operation by using the procedures discussed in Section 4.2.2.

In many cases it is possible to comply with OSHA guidelines while using higher alarm points than those used by Biosystems. It is important to note that the default alarm point settings used in the PhD Lite design are very conservative in order to provide maximum worker safety.

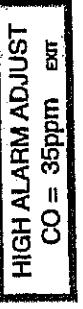
- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1. Then use the navigation buttons to move to the "ALARMS" selection and press the mode button.



- (2) Use the navigation buttons to move to the "CUSTOM" selection and press the mode button.



- (3) Use the right or left navigation button to select which sensor to change the alarm setting.



- (4) Use the up or down navigation buttons to modify the current setting.



- (5) When the alarm adjustment for a particular sensor is completed, use the navigation buttons to advance to the next alarm type to be modified.

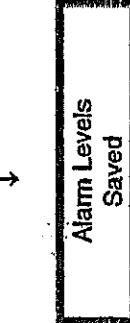
- (6) Press the mode button to exit and save the new alarm settings.



- (3) Use the right or left navigation button to view the default alarm settings for each sensor installed.



- (4) Press the mode button to exit and to change the alarms to the default settings.



4.2.2. Viewing current or restoring the factory default alarm settings

PhD Lite alarm settings are set at the factory in the most conservative way possible. Factory default settings may be restored at any time while the instrument is being operated in either the Basic or Technician operating mode by doing the following:

4.2.2.1. Viewing or restoring factory default alarm settings

- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1. Then use the navigation buttons to move to the "ALARMS" selection and press the mode button.



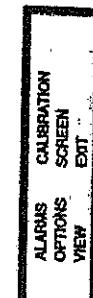
4.2.2.2. Viewing current alarm settings

- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1. Then use the navigation buttons to move to the next alarm type to move to the

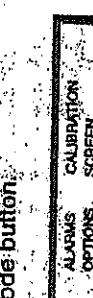
4.3.1.5.1 Enable/Disable Passcode

To enable or disable the passcode option, perform the following steps:

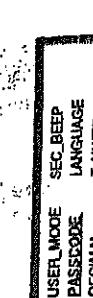
- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.



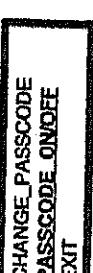
- (2) Use the navigation buttons to select the "OPTIONS" selection and then press the mode button.



- (3) Use the navigation buttons to move to the "PASSCODE" selection and press the mode button.



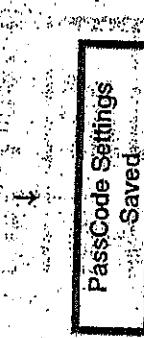
- (4) Use the navigation buttons to select "Passcode ON/OFF" setting and then press the mode button to enable or disable the passcode option.



- (5) Use the navigation buttons to toggle between "Enabled" and "Disabled". Press the mode button to make the selection.



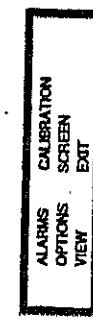
- (6) Press the mode button to save the selection.



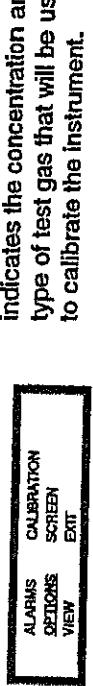
4.3.1.5.2 Changing the Passcode

To change the current passcode setting, perform the following steps:

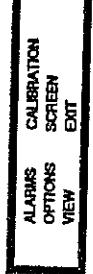
- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.



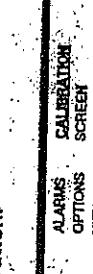
- (2) Use the navigation buttons to select the "OPTIONS" selection and then press the mode button.



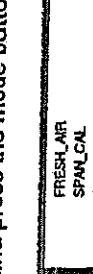
- (3) To move to the "PASSCODE" selection and then press the mode button.



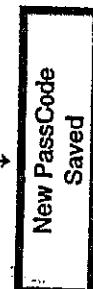
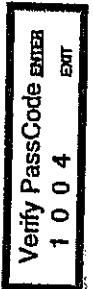
- (4) Use the navigation buttons to move to the "GAS VALUES" selection and then press the mode button.



- (5) Use the navigation buttons to move to the "GAS VALUES" selection and then press the mode button.



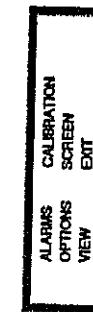
- (6) Use the navigation buttons to move to the "GAS VALUES" selection and then press the mode button.



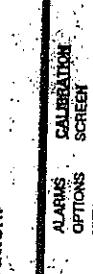
4.3.1.6 Calibration gas concentration

The calibration gas screen indicates the concentration and type of test gas that will be used to calibrate the instrument.

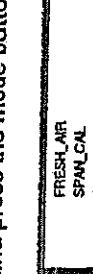
- (1) To move to the "Instrument Setup Main Menu" screen, see section 4.1.1.



- (2) Use the navigation buttons to select the "CALIBRATION" selection and then press the mode button.



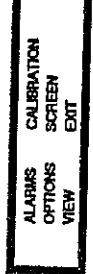
- (3) Use the navigation buttons to select the "GAS_VALUES" selection and then press the mode button.



- (4) Use the navigation buttons to select the "GAS_VALUES" selection and then press the mode button.



- (5) To move to the "Main Menu" screen, see section 4.1.1.



(4) Press the left or right navigation button to select the calibration gas concentration.

CALIBRATION GAS
LEL . 50.0% **EXIT**



CALIBRATION GAS
CO 50ppm **EXIT**



(5) Pressing the up or down navigation button will change the gas concentration.

CALIBRATION GAS
H2S 20.0ppm **EXIT**



CALIBRATION GAS
H2S 20.0ppm **EXIT**

(6) Press the mode button to exit and save the new setting.

Save Changes?
YES NO CANCEL



CAL GAS VALUES
SAVED

Warning: Verify that the concentration printed on the label of the calibration gas cylinder that will be used matches the concentration shown on the "Calibration Gas Concentration" screen.

Assigning the wrong concentration may cause improper adjustment during "Auto Calibration" procedures, and lead to dangerous inaccurate readings during normal operation. Changing the calibration gas concentration to be used by the instrument during "Auto Calibration" procedures is reserved for authorized personnel.

4.3.1.6.1. "CO Plus" sensor calibration gas screen

The "CO Plus" sensor may be calibrated to either hydrogen sulfide or carbon monoxide. If a "CO Plus" sensor is currently installed it is possible to change the type of calibration gas that will be used at this time.

Warning: The gas that is chosen must be the gas that is actually used during calibration. Refer to 3.1.1.5 for details. Changing

the cal gas used to calibrate the CO Plus sensor is reserved for authorized personnel.

(1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

ALARMS **CALIBRATION**
OPTIONS **SCREEN**
VIEW **EXIT**

(2) Use the navigation buttons to select the "Calibration" selection and then press the mode button.

ALARMS **CALIBRATION**
OPTIONS **SCREEN**
VIEW **EXIT**

(3) Use the navigation buttons to move to the "Select Gas_Values" and press the mode button.

FRESH AIR **SPAN CAL**
GAS VALUES **EXIT**

(4) Press the left or right navigation button to select the calibration gas type.

CALIBRATION GAS
LEL . 50.0% **EXIT**



CALIBRATION GAS
CO 50ppm **EXIT**

(5) Press the left navigation button to select the calibration gas type.

(5) Press the left navigation button to select the calibration gas type.

CALIBRATION GAS
CO 50ppm **EXIT**

(6) Press the up or down navigation button to change the calibration gas type.

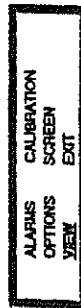
CALIBRATION GAS
CO 50.0ppm **EXIT**

(7) Press the mode button to exit and save the new setting.

Save Changes?
YES NO CANCEL

CAL GAS VALUES
SAVED

- (2) Use the navigation buttons to select the "VIEW" selection and then press the mode button.



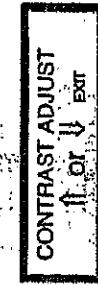
- (3) Use the navigation buttons to move to the selection desired and press the mode button.



- (3) Use the navigation buttons to move to the selection desired and then press the mode button.



- (4) Use the up and down navigation keys to change the contrast.



4.5. Display Settings

The PhD Lite display screen is designed so that the user may adjust the screen settings for improved viewing.

4.5.1. Display Screen Contrast

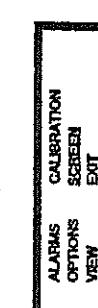
The time the backlight remains on after activation can be set anywhere from 5 to 90 seconds or can be left on as long as the PhD Lite is on.

- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

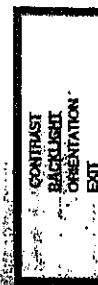


- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

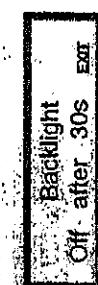
- (2) Use the navigation buttons to select the "SCREEN" selection and then press the mode button.



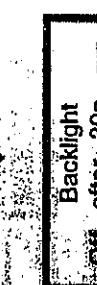
- (2) Use the navigation buttons to move to the "BACKLIGHT" selection and press the mode button.



- (4) Press the left or right navigation button once to move the cursor from "EXIT" to "OFF" then press the right navigation key again to move to the time duration.

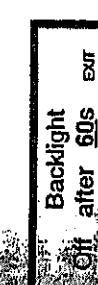


- (7) Move the cursor to "EXIT" and press the mode button to exit and save the changes.

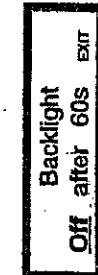


- (7) Move the cursor to "EXIT" and press the mode button to exit and save the changes.

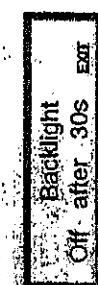
- (3) Press the up or down navigation button to change the current backlight duration.



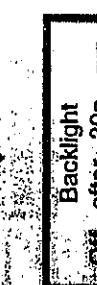
- (6) To keep the duration setting skip to step 7, otherwise to leave the backlight on permanently, press the right navigation button to the "Off" setting. Next press the up or down navigation button to change the setting from "Off" to "On".



- (4) Press the left or right navigation button once to move the cursor from "EXIT" to "OFF" then press the right navigation key again to move to the time duration.

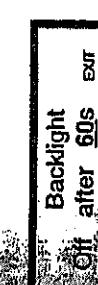


- (7) Move the cursor to "EXIT" and press the mode button to exit and save the changes.



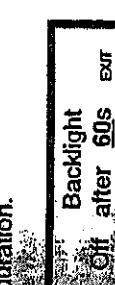
- (7) Move the cursor to "EXIT" and press the mode button to exit and save the changes.

- (3) Press the up or down navigation button to change the current backlight duration.



4.5.3. Display Screen Orientation

- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1.



ALARMS **CALIBRATION**
OPTIONS **SCREEN**
VIEW **EXIT**

- (2) Use the navigation buttons to select the "SCREEN" selection and then press the mode button.

ALARMS **CALIBRATION**
OPTIONS **SCREEN**
VIEW **EXIT**

- (3) Use the navigation buttons to move to the "ORIENTATION" selection and press the mode button.

CONTRAST
BACKLIGHT
ORIENTATION
DISPLAY
EXIT

- (4) Use the up and down navigation keys to change the display.

DISPLAY
UP or **DOWN** to Flip
DISPLAY
EXIT

- (5) Press the mode button to save the orientation setting.

4.6. Record Keeping

When equipped with the optional datalogging capability, the PhD Lite can store the exposure values for up to 2917 datalogging intervals when using a typical four channel configuration such as O₂, LEL, CO, H₂S. This provides for storage of up to 48 hours and 41 minutes of four gas

remembers (logs) gas readings, as well as other important information such as turn-on / turn-off times, temperature, battery condition, the 8 most recent calibration dates and settings, types of sensors currently installed, sensor serial numbers, warranty expiration and service due dates, temperature compensation curves, and current alarm settings.

The PhD Lite automatically updates and notes all of this information when the instrument is turned on, whenever a change is made during operation, and again as the instrument is turned back off.

If a sensor is changed or replaced the PhD Lite notes that a change has occurred, displays a "Needs Cal" message the next time the instrument is turned back on, and identifies the affected sensors. Even if the change is only to replace one sensor with another of the same kind, the PhD Lite will still note the change in serial numbers of the sensors installed, and display the "Needs Cal" message.

Although it is not necessary to make use of information being recorded and stored by the PhD Lite, it is there in the event it is needed.

4.6.2. Optional Datalink and Gas Detection Database Software Kit

Biosystems optional "Datalink" kits allow two-way communication between your PhD Lite and an IBM compatible personal computer. Two kits are available: The "Datalink Software Kit" which includes software and reference manual and the "Datalink Kit" which includes datalogging board, software, and reference manual.

Datalink software serves two basic functions: getting stored information out of the instrument and into your computer, and using files stored in your computer to setup or "program" your PhD Lite.

It is important to note that it is not necessary to use the Datalink software to program your instrument. Configuration and setup options may be programmed directly by using the built-in buttons on the instrument keypad.

Datalink software has been designed to make programming, downloading, and data analysis as easy as pushing a button. The software allows optional instrument setups to be created by "filling out" forms right on the computer screen.

Note: The PhD Lite is designed to download data from the instrument to a PC using an IrDA compliant infrared data transceiver. It may be necessary to purchase an IrDA transceiver if your computer is not equipped with this feature. Many newer laptop style PC's have this feature built into them however, many desktop and older laptop style PC's may not. Consult your owners' manual for details. If you must purchase an IrDA transceiver a good example would be the ACTiSYS IR wireless interface (model number ACT-IR220E) which can be purchased directly through ACTiSYS or Biosystems.

Without this transceiver or built in feature on your PC you will not be able to download PhD Lite data logging information.

Most functions (such as downloading stored information from the instrument to your PC, or uploading configuration setup files from your PC to the instrument) are automatic. The software is designed to help you along.

Once information has been "downloaded" to the computer, it may be used for a variety of purposes. Data may be displayed and reviewed in detail through the computer monitor screen, or used to automatically generate and print reports, tables

and graphs of time history exposure data. It is also possible to export records to other software applications in the form of ASCII text or a spreadsheet format. Another option is to simply retain downloaded records of your gas detection monitoring program.

Note: The material in this chapter is primarily designed to acquaint our customers with "manual" PhD Lite setup and download procedures. Consult the Datalink Reference Manual for complete instructions in the use of Datalink software.

4.6.3. Installing the data logging board

If the PhD Lite was not purchased with data logging capabilities it is necessary to remove the standard alarm board and replace it with a data logging alarm board. The data logging alarm board can be purchased by itself or as part of the PhD Lite Datalink Kit.

Note: A PhD Lite with firmware version 1.04 or earlier must be sent back to the factory for the data logging up grade.

Note: Instruments with firmware version 1.06 or higher are field serviceable. Installation of the data logging board requires opening of the instrument and removing an

electronic component that is attached to the main circuit board of the detector. Unauthorized persons should not do this procedure. In many cases, it may be better to return the detector to the factory for this procedure.

To install the data logging board:

- (1) Make sure the unit is turned off. If working with an alkaline unit, remove the batteries.
- (2) Remove all sensors using the procedures discussed in section 5.1 of chapter five. Make sure the instrument is off before removing sensors!

- (3) Remove the six screws from the back of the unit and separate the case as shown in Figure 4.6.3.1.

- Note:** Notice which screws came from which side. When looking at the back of a NiMH battery with the IRDA Interface printing up, the screws on the left are longer than those on the right. Also make sure the O-rings are attached to the screws after they are removed.)
- (4) Carefully lift the main board from the housing and disconnect the alarm board as shown in Figure 4.6.3.2.

- (5) Slide the datalogging alarm board into the guides behind the IRDA lens as shown in Figure 4.6.3.3..
- (6) Gently push the main board into the case top. Make sure all wires are connected and that the datalogging alarm board is aligned properly so it snaps easily onto the main board.
- (7) Align the gasket in the grooves around the case top and around the rear contact connector, then align the side grips to the case as shown in Figure 4.6.3.4.
- (8) Using the hardware that was removed attach the case bottom to the case top. Make sure each screw has an O-ring attached to it before securing it to the case top. Be careful not to pinch any wires or the gasket when attaching the case bottom to the case top, and make sure the screws are in their proper locations (refer to step 3).
- (9) Replace the sensors and sensor cover (and batteries then secure the battery door if working with an alkaline unit.)
- (10) Turn the instrument on and make sure all configuration, alarm and service due

settings are correct then
configure and set the date in
the datalogger as shown in
section 4.6.4.2.

(11) Calibrate the instrument
before returning it to
service.

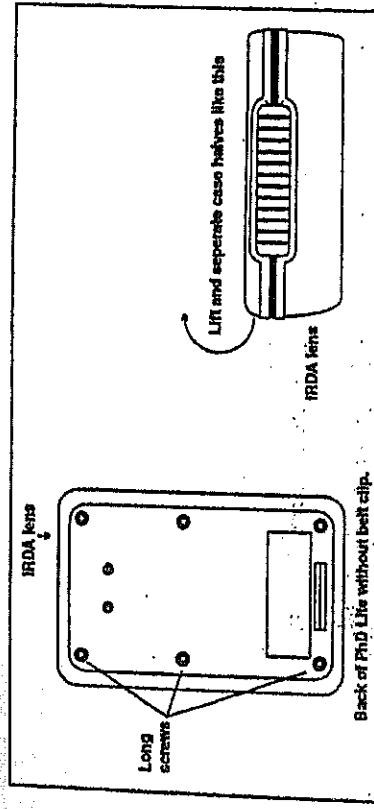


Figure 4.6.3.1. Opening the unit

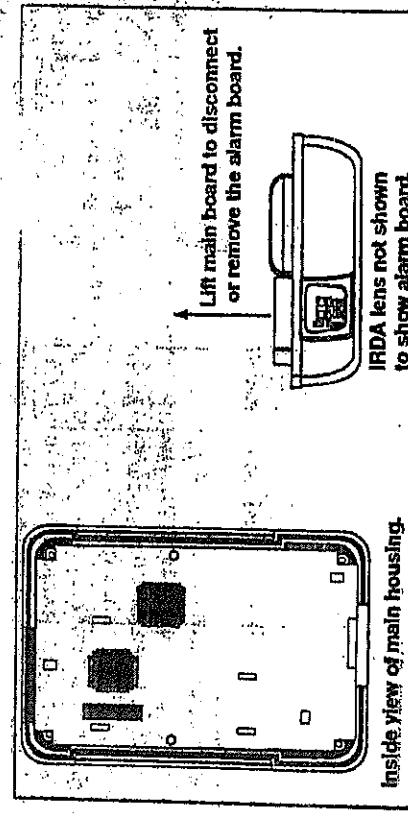


Figure 4.6.3.2. Removing alarm board

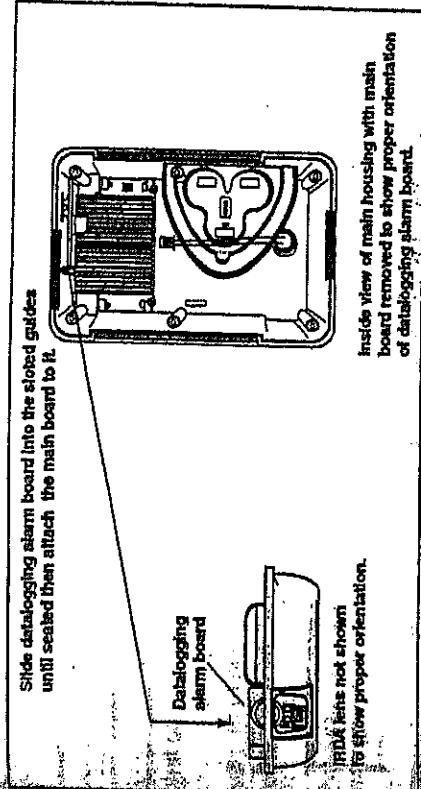


Figure 4.6.3.3. Installing datalogging alarm board

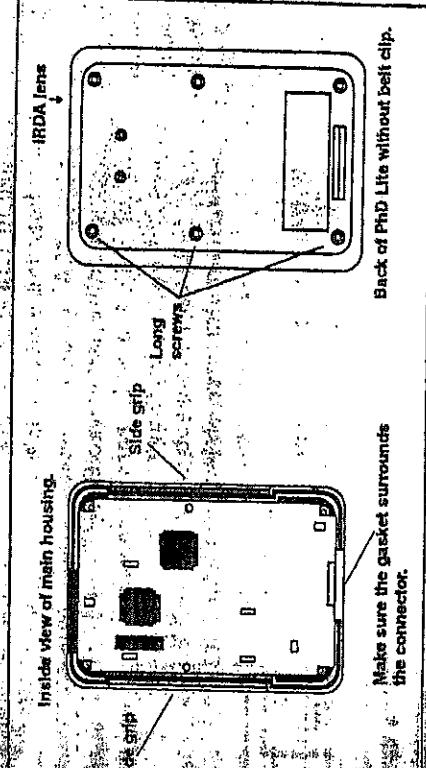


Figure 4.6.3.4. Closing the unit

4.6.4. Configuring the datalogger

It is possible to adjust or customize the way the PhD Lite logs data in a number of different ways. Options include extended recording time, tagging the exposure data with time and date information, or assigning a location number.

4.6.4.1. Setting the Time/Date

Once the PhD Lite has been upgraded with the datalogging feature it will begin logging data immediately. This makes it necessary to set the date and time after the instrument has been upgraded.

Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

- To set the date and time use the navigation buttons to move to the "DATALOGGER" and press the mode button.



- Use the navigation buttons to move to the "TIME/DATE" selection and press the mode button

longer sampling interval allows the retention of more hours of data. If a longer interval is selected, the detector is able to log more hours of monitoring data, making the PhD Lite ideal for long-term sampling projects.

Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

Date 23 Aug 1998
Time 10:42 EXIT



Date 23 Sep 1998
Time 10:42 EXIT



- After the instruments clock has been set to the current time and date, move the cursor to "EXIT" and press the mode button to exit and save the changes.

Date 23 Sep 1998
Time 10:42 EXIT



Save Changes?
YES NO CANCEL



Time / Date Saved

INTERVAL
TIME/DATE
SESSIONS
COMM
DATE
EXIT

- Press the up or down navigation button to change the current date or time field. Use the right or left navigation button to move the cursor to the next field.

4.6.4.2. Adjusting the sampling interval

When the PhD Lite is equipped with the optional datalogger and is turned on it immediately begins to monitor, calculate, and log exposure levels for the atmospheric hazards it is set up to detect.

For the purposes of developing a time history chart or graph this continuous data stream must be broken into discrete intervals before being logged. The sample interval screen allows the user to adjust how frequently this data is recorded.

Note: Calculations that are made on a running basis (i.e. TWA, STEL, Ceilings, and Peak exposure values) are updated at regular intervals by the PhD Lite microprocessor.

Adjusting the sampling interval used by the PhD Lite to generate time history exposure files does not alter the way in which TWA, STEL, Ceiling, and Peak exposure values are calculated.

The sampling interval may be set anywhere between one second and one hour by using the navigation buttons. The PhD Lite is capable of logging various intervals of data. In the event the memory is full, the PhD Lite is designed to hold-on to the most recent data intervals. Selecting a

longer sampling interval allows the retention of more hours of data. If a longer interval is selected, the detector is able to log more hours of monitoring data, making the PhD Lite ideal for long-term sampling projects.

- Use the navigation buttons to select the "DATALOGGER" selection and press the mode button.

ALARMS
CALIBRATION
SCREEN
DATALOGGER
EXIT

- Use the navigation buttons to select the "INTERVAL" selection and press the mode button.

INTERVAL
TIME/DATE
SESSIONS
COMM
DATE
EXIT

- Press the up or down navigation button to turn the datalogger on or off.

Sampling Interval
Off
EXIT

Sampling Interval
On 01m 00s
EXIT

It is possible to set or view "Service Due" dates for each sensor currently installed.

- (4) Press the right navigation button to move the cursor from "On" to the minutes or seconds display. Use the up or down navigation button to set the sampling interval time. Notice that the hours and minutes available for datalogging change as the interval time is set.

Sampling Interval
On 02m 00s EXIT

Sampling Interval
On 02m 30s EXIT

- (5) Move the cursor to "EXIT" and press the mode button to exit and save the changes.

Sampling Interval
On 02m 30s EXIT

↓

Save Changes?
YES NO CANCEL

↓

Sampling Interval
Saved

4.6.5. Sensor service due date

- 4.6.5.2. Changing the sensor service due date
- To change the current sensor service due date setting, perform the following steps:
- Move to the "Instrument Setup Main Menu" as described in section 4.1.1.
- (1) Use the up and down navigation buttons to toggle between "Enabled" and "Disabled".
- O2 Service Date
DISABLED EXIT
- ↑
- (2) Use the right and left navigation buttons to move to the next sensor type.
- O2 Service Date
ENABLED EXIT
- ↓
- O2 Service Date
ENABLED EXIT
- LEL Service Date
DISABLED EXIT
- ↓
- CO Service Date
DISABLED EXIT
- (3) Use the navigation buttons to move to the "SERV DATE" selection and press the mode button.
- CALIBRATION
SCREEN
DATALOGGER
EXIT
- ALARM
OPTIONS
VIEW
D.I. INFO
- INTERVAL
TIME/DATE
SERV DATE
- CLEAR DL
SESSIONS
COMM
EXIT
- INTERVAL
TIME/DATE
SERV DATE
- (4) Use the navigation buttons to select the "CHANGE SERV DATE" setting and then press the mode button.
- CHANGE SERV DATE
SERVICE, ON/OFF
EXIT
- Save Changes?
YES NO CANCEL
- ↓
- Sensor Service
Saved

down navigation buttons to change the current setting.

Next-O2-Service
NEXT
EXIT
26 OCT 1998



Next-O2-Service
NEXT
EXIT
26 OCT 1998



- (5) Move to the "NEXT" option to move to set the next sensor. After all sensors have been set move the cursor to "EXIT" and press the mode button to exit and save the changes.

Next-O2-Service
NEXT
EXIT
26 OCT 1998



Save Changes?
YES NO CANCEL



Sensor Service
Saved



4.6.6. User and location

It is possible, if desired, to assign alphanumeric identification codes of up to 14 characters each which specify the user and location where a particular monitoring session is to occur. This information will automatically be added to all downloaded records and reports of the monitoring session.

It is possible to enter up to 15 users and up to 20 locations in the instrument memory through use of the navigation buttons on the instrument keypad or, by using Biosystems' Datalink software to upload the lists from a personal computer. It is also possible to modify the current user name and monitoring location directly through use of the navigation buttons on the instrument keypad.

Once the lists are in the instrument memory it is possible to "scroll" through the available choices and either pick the appropriate name and location from the list, or enter new information.

4.6.6.1. Making User lists through the instrument

Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

ALARMS
OPTIONS
VIEW
ID_INFO
CALIBRATION
SCREEN
DATALOGGER
EXIT

<
USER #1
>
NEXT
EXIT

(1) Use the navigation buttons to select the "ID_INFO" selection and press the mode button.

ALARMS
OPTIONS
VIEW
ID_INFO
CALIBRATION
SCREEN
DATALOGGER
EXIT

<
USER #1
>
NEXT
EXIT

(2) Use the navigation buttons to move to the "USER_LIST" selection and press the mode button.

USER_LIST
USER_ID
LOCATION
MACID
EXIT

<
USER #1
>
NEXT
EXIT

(3) After completing the user ID press either the left or right navigation key until the "NEXT" selection is highlighted. Press the mode button to continue entering user ID's.

<
JOE
USER #1
>
NEXT
EXIT

(4) After completing the user ID press either the left or right navigation key until the "NEXT" selection is highlighted. Press the mode button to continue entering user ID's.

<
JOE
USER #1
>
NEXT
EXIT

<
USER #1
>
NEXT
EXIT

SELECT CHARACTER
ABCDEFIGHJKLMNOPQRS
TUVWXYZ1234567890

Save Changes?
YES NO CANCEL

highlighted. Use the down navigation key to select Exit and press the mode button to save.

- (5) making changes.

(2) Use the navigation buttons to move to the "USER_ID" selection and press the mode button. Press the mode button to view the user list



ALARMS **CALIBRATION**
OPTIONS **SCREEN**
VIEW **DATALOGGER**
FINISH **EXIT**

- ```

graph TD
 A[User ID
Loc List
Touch ID] --> B[User List
Loc List
Touch ID]
 B --> C[Save Changes?
Yes
No
Cancel]

```

selection and press the mode button.

- (2) Use the navigation buttons to move to the "USER\_ID" selection and press the mode button. Press the mode button to view the user list

 USER LIST  
LOC LIST  
TOUCH ID

↓

(3) The "LIST" selection will be highlighted. Press the mode button to view the user list. Use the left and right navigation buttons to scroll through the list of user IDs. Once a user is selected press the mode button

 < USER ID  
> LIST  
ENTER  
EXIT

↓

(4) After selecting a User use navigation keys to select Exit and press the mode button to save.

 Save Changes?  
YES NO CANCEL

↓

(5) Use the navigation buttons to move to the "LOC\_ID" selection then press the mode button.

 USER LIST  
LOC LIST  
TOUCH ID  
< Location  
> LIST  
ENTER  
EXIT

↓

(6) The "LIST" selection will be highlighted. Press the mode button to view the location list. Use the left and right navigation buttons to scroll through the list of locations. Once a location is selected press the mode button

 <Room 1  
Location #1  
< Room 1  
Location  
ENTER  
EXIT

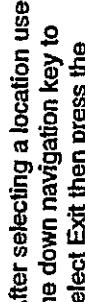
↓

(7) After selecting a location use the down navigation key to select Exit then press the mode button to save.

 ALARMS  
CALIBRATION  
SCREEN  
DATALOGGER  
EXIT  
ID\_INFO  
<Room 1  
Location  
ENTER  
EXIT

↓

(8) Use the navigation buttons to select the "ID\_INFO" selection

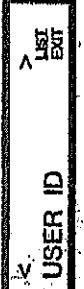
 ALARMS  
CALIBRATION  
SCREEN  
DATALOGGER  
EXIT  
ID\_INFO  
<Room 1  
Location  
ENTER  
EXIT

selection and press the mode button.

- (2) Use the navigation buttons to move to the "USER\_ID" selection and press the mode button. Press the mode button to view the user list



(3) The "LIST" selection will be highlighted. Press the mode button to view the user list. Use the left and right navigation buttons to scroll through the list of user IDs. Once a user is selected press the mode button



(4) After selecting a User use navigation keys to select Exit and press the mode button to save.



(5) Use the navigation buttons to move to the "LOC\_ID" selection then press the mode button.



(6) The "LOCATION" selection will be highlighted. Press the mode button to view the location list. Use the left and right navigation buttons to scroll through the list of locations. Once a location is selected press the mode button



(7) After selecting a location use the down navigation key to select Exit then press the mode button to save.



**highlighted.** Use the down navigation key to select **Ex** and press the mode button to save.

ID is changed after the first two minutes of a session, a new session is automatically started.

O2 LEL CO H2S SO2  
20.9 0 0 0 0

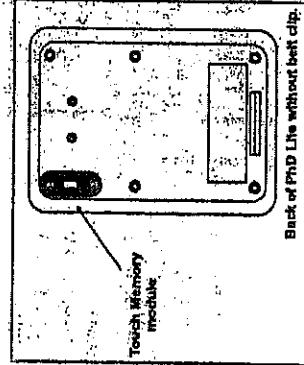
Press the "Touch Memory Button" to PhD Lite.

USER IS NOW  
JOHN

O2 LEL CO H2S  
20.9 0 0 0 0

- ↓
- Save Changes?  
YES NO CANCEL
- ↓
- Current Location  
Saved
- (6) Exit the main menu and a new session will begin using the current location and user.

STARTING NEW  
SESSION



#### 4.7.1 Using Touch Memory

When the PhD Lite is equipped with the optional "Touch Memory module" it is possible to change the User or Location ID's currently stored in the instrument memory. Press a "Touch Memory Button" to the "Touch Memory Module" on the back of PhD Lite while the instrument is in normal gas detection mode.

The User or Location ID must be set within the first two minutes of a session. If the User or Location

#### 4.7.2 Programming the User/Location touch memory Button

When the PhD Lite is equipped with the optional "Touch Memory module" it is possible to program the current User or Location into a touch memory button. It is also possible to change the User or Location ID's stored in the PhD Lite touch memory button to a Current Location or User ID stored in the PhD Lite memory. Touch memory buttons can be programmed one at a time through the instrument or by using the TouchID software kit (See section 4.7.3).

Note: Only one user or one location can be programmed into a touch memory button.

Note: When programming a user ID the set language and user mode are stored along with the user name. These settings are restored to the instrument when the user ID button is applied to the instrument during normal operation.

4.7.2.1 Programming a touch memory button for a current location or user through the instrument.

To program a touch memory button for a current location or user move to the "Instrument

Setup Main Menu" as described in section 4.1.1.

Note: Make sure the user and/or location that you would like programmed into a button are currently in use.

ALARM  
OPTIONS  
VIEW  
ID\_INFO  
CALIBRATION  
SCREEN  
DATALOGGER  
EXIT

(1) Use the navigation buttons to select the "ID\_INFO" selection and then press the mode button.

ALARMS  
OPTIONS  
VIEW  
ID\_INFO  
CALIBRATION  
SCREEN  
DATALOGGER  
EXIT

(2) Use the navigation buttons to move to the "TOUCH\_ID" selection and press the mode button.

USER\_LIST  
LOC\_LIST  
TOUCH\_ID  
CALIBRATION  
SCREEN  
DATALOGGER  
EXIT

(3) Use the navigation buttons to select "LOCATION\_MEMORY" if the Location ID touch memory button is to be programmed. Select "USER\_ID\_MEMORY" if the user ID touch memory button is to be programmed, then press the mode button.

LOCATION\_MEMORY  
USER\_ID\_MEMORY  
CLEAR\_MEMORY  
EXIT

### Programs menu item in the Start Menu.

Options in the installation program allow for shortcuts to the TouchID program to be created directly on the Windows™ desktop or directly on the Start Menu.

### 4.7.3. Touch ID programming

If your Biolytics datalogging gas-detector was ordered with the optional TouchID Memory Programming Kit then you are fully equipped to easily program any name or location into a TouchID memory button.

#### 4.7.3.1. Installing TouchID software on Windows™ 95/98

The first time that the TouchID program is run it will be necessary to select the COM port that the TouchID remote programmer is connected. The TouchID program will automatically search for a button touching the remote programmer to set the COM port click on the "Stop" button with the mouse.

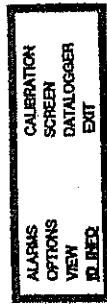
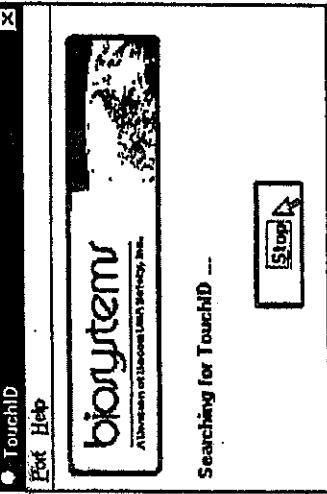
#### 4.7.3.2. Setting the COM port

1. Insert disk 1 into your floppy drive.  
2. Select Start on your Windows™ 95/98 main menu.

3. Next select Run.  
4. Type in a:setup and click on OK.

#### 4.8. TouchID software and help

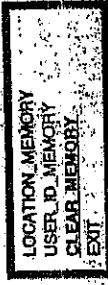
This can be accessed using the Biolytics menu under the



- (2) Use the navigation buttons to move to the "TOUCH\_ID" selection and press the mode button.



- (3) Use the navigation buttons to select "CLEAR MEMORY", then press the mode button.



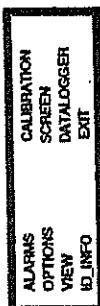
#### 4.7.2.2. Clearing the User or Location touch memory button

To clear the current touch memory User or Location ID stored in the touch memory button, perform the following steps:  
Move to the "Instrument Setup Main Menu" as described in section 4.1.1.

- (4) Press the touch memory module and hold until the screen displays that the card has been found and deleted.

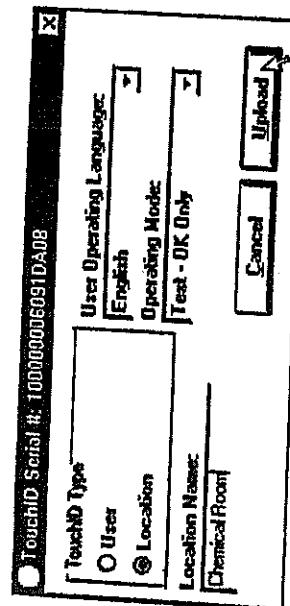


- Once the memory button has been cleared it can be reprogrammed for another user or location see section 4.7.2.1.
- (1) Use the navigation buttons to select the "ID\_INFO" selection then press the mode button.

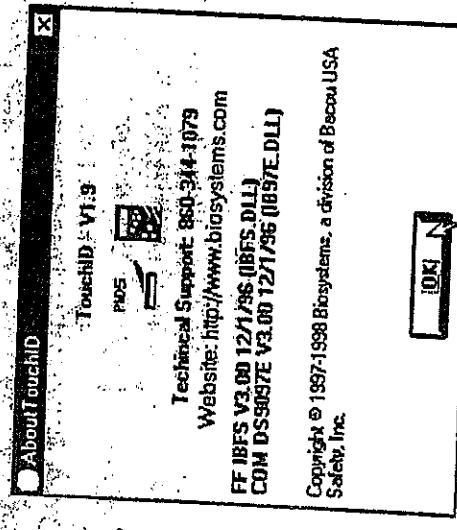


Once the changes have been made just click on "Upload" while pressing the end of the

TouchID remote programmer onto the TouchID button.



To view information about the TouchID software, select the "About TouchID" item from the Help menu to find out the Software Version, Software Date,



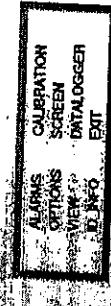
To exit the TouchID software select "Exit" which is found under the "Port" menu selection

or click on the  in the upper right hand corner of the screen.

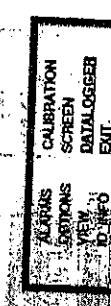
#### 7.8 View recorded session information

It is possible to view recorded session summaries currently stored in the instrument memory without having to download the data to a computer.

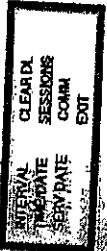
Move to the "Instrument Setup Main Menu" as described in Section 4.1.



(1) Use the navigation buttons to select the "DATALOGGER" selection and then press the mode button.



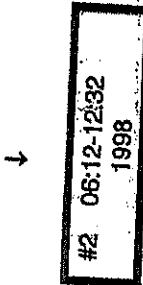
(2) Use the navigation buttons to move to the "SESSIONS" selection and press the mode button.



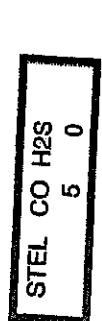
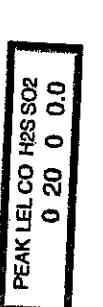
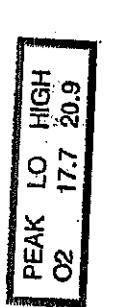
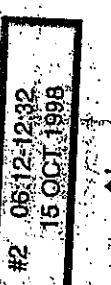
(3) The data is stored in the instrument memory then the following screen will be displayed.

#### NO INFORMATION AVAILABLE

(4) If data has been previously stored in the instrument memory, use the left and right navigation buttons to select the session to view.



(5) Use the up or down navigation button to view the data for the session selected.



for specific software details.  
Download can not be  
transmitted without the use  
of an IrDA transceiver see  
note in section 4.6.2. for  
details.

AVERAGE CO H2S  
21.1 0



AVERAGE CO H2S  
4 0



ID: Joe  
L.C. Room 1



(6) Press the mode button to  
exit and return back to the  
menu selection screen.

CALIBRATION  
SCREEN  
DATALOGGER  
EXIT

4.8.1. Downloading session  
information to a PC.

Biosystems optional "Datalink"  
kit allows two-way  
communication between your  
PhD Lite and an IBM  
compatible personal computer.

Note: This is just an  
overview about establishing  
communication from the unit  
to the PC. Consult the  
Datalink reference manual

If the PhD Lite is off you can  
start it in "COMM" mode and  
immediately download  
information to the PC and  
avoid the start up screens. To  
do this press and hold the  
mode button for three seconds  
until the following screen  
appears.

COMMUNICATION  
MODE

Once the screen reads  
"COMMUNICATION MODE"  
the LED's will illuminate and  
you will have 30 seconds to  
align the instrument with the  
IrDA transceiver and start  
downloading.

Once the data has been  
viewed and/or saved exit the  
program and the unit will shut  
down.

If the instrument is already on  
and you would like to download  
the current information from  
the instrument do the following:

Move to the "Instrument Setup  
Main Menu" as described in  
section 4.1.1.

ALARMS CALIBRATION  
OPTIONS SCREEN  
VIEW DATALOGGER  
ID INFO EXIT

(1) Use the navigation  
buttons to select the  
"DATALOGGER" selection  
and then press the mode  
button.

ALARMS CALIBRATION  
OPTIONS SCREEN  
VIEW DATALOGGER  
ID INFO EXIT

(2) Use the navigation buttons  
to move to the "COMM"  
selection and press the  
mode button.

INTERVAL CLEAR ALL  
IMMEDIATE SESSIONS  
SERV DATE COMM  
EXIT

TO COMM MODE?  
YES NO

SAVING INSTRUMENT  
DATA

On the screen reads  
SAVING INSTRUMENT

Note: This procedure only  
clears data recorded during

"DATA" the LED's will illuminate  
and you will have 30 seconds  
to align the instrument with the  
IrDA transceiver and start  
downloading. Once the data  
has been viewed and/or saved  
exit the program and the unit  
will shut down.

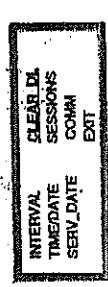
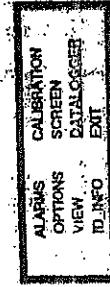
The PhD Lite can store the  
monitoring results for various  
intervals in instrument memory  
at any time. When monitoring  
data is downloaded to a  
personal computer, the entire  
contents of the memory are  
transmitted. That means the  
amount of time required for  
downloading is dependent on  
the amount of recorded  
information in the instrument  
memory. Once monitoring  
data has been successfully  
downloaded there is usually no  
reason to retain it in instrument  
memory as well.

Caution: Make sure that any  
session information which  
will be needed later is safely  
downloaded and stored prior  
to clearing the instrument  
memory. Once session data  
has been cleared it is  
permanently lost to future  
use!

monitoring sessions, Alarm settings, calibration adjustments, user names and locations and feature settings are not affected by this procedure.

- (1) Move to the "Instrument Setup Main Menu" as described in section 4.1.1. Then use the navigation buttons to move to the "DATALOGGER" selection and press the mode button.

- (2) Use the navigation buttons to move to the "CLEAR DL" selection and press the mode button.



- (3) Use the right or left navigation button to select whether to clear the instrument memory. Press the mode button to accept the selection and exit.



Clear Datalogger?  
YES NO



**CLEARING  
DATALOGGER**

## Chapter 5: Trouble-shooting and repair

**Warning:** Repair procedures may only be performed by authorized personnel.

To replace a sensor:

- (1) Make sure the PhD Lite is turned off.
- (2) Loosen the three screws holding the sensor compartment cover in place and remove the cover.
- (3) Identify which sensor you wish to replace.
- (4) Gently pull the sensor out of its socket.
- (5) Press the replacement sensor into place.
- (6) Make sure the correct color coded filter cap is replaced along with the new sensor. (The color of the filter holder should match the color of the ID ring on the upper surface of the sensor.)
- (7) Allow at least one to two hours for the sensor to stabilize.

The PhD Lite must be turned off prior to removing or replacing sensors. A Phillips screwdriver is used to remove the three screws securing the sensor cover to the PhD Lite case.

**Note:** Corrosive sensors such as ammonia, hydrogen cyanide, nitric oxide, chlorine and nitrogen dioxide may require up to 24 hours for full stabilization.

|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (8) Replace the sensor compartment cover. | <b>High" or "Too Low" for zero adjust)</b> | The atmosphere in which the instrument is located is contaminated (or was contaminated at the time the instrument was last zeroed); instrument is still attached to calibration fittings; a new sensor has just been installed; instrument has been dropped or banged since last turned on.                                                                                                                                                                                                                                                                                         | <b>Possible causes:</b> | Remove any calibration gas fittings, take the instrument to fresh air and allow readings to stabilize. Do a manual fresh air zero adjustment using buttons on the instrument keypad as discussed in <b>Section 3.5.1</b> .                                                                                                                                               |
| (9) Recalibrate the new sensor.           | <b>5.1.1. Toxic Sensor Restrictions</b>    | From time to time Biosystems may release a new type of toxic sensor, or make changes to existing sensors in order to improve performance. In some cases it may be necessary to make changes to the PhD Lite before making use of the new sensor. If a sensor which is not compatible with the current configuration of the instrument is installed, a message stating that the sensor is "Not Supported" will be displayed at the time the instrument is turned on. Please contact the Biosystems Service Center at (860)344-1079 for an explanation of the required modifications. |                         |                                                                                                                                                                                                                                                                                                                                                                          |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>Solution(s):</b>                                                                                                                                                                                                                                                                                                                                                      |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | Remove any calibration gas fittings, take the instrument to fresh air and allow readings to stabilize. Do a manual fresh air zero adjustment using buttons on the instrument keypad as discussed in <b>Section 3.5.1</b> .                                                                                                                                               |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>5.2. Troubleshooting</b>                                                                                                                                                                                                                                                                                                                                              |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | There are a few troubleshooting and repair procedures besides sensor and battery replacement which can be done in the field.                                                                                                                                                                                                                                             |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>5.2.1. Specific problems</b>                                                                                                                                                                                                                                                                                                                                          |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>5.2.1.1. Problem: Can't make a "One Button" auto zero adjustment (LCD shows "Too</b>                                                                                                                                                                                                                                                                                  |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>adjust"</b> )                                                                                                                                                                                                                                                                                                                                                         |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | pump is operated without the sample probe assembly in place, or in particularly dirty atmosphere, this internal filter can become clogged and periodically require replacement. Standard accessories included with every 54-26-0101 motorized pump include a package of 10 replacement 61-001 filters.                                                                   |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>5.3. Motorized pump maintenance</b>                                                                                                                                                                                                                                                                                                                                   |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | Use of the optional motorized sample draw pump (part number 54-26-0101) allows the PhD Lite to continuously monitor locations which are remote from the instrument. The slip-on pump obtains power directly from the PhD Lite battery, and runs continuously as long as the instrument is turned on. The instrument constantly monitors the pump for proper performance. |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>5.3.1. Internal pump filter replacement</b>                                                                                                                                                                                                                                                                                                                           |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | Use the following procedure for replacing the internal pump filter:                                                                                                                                                                                                                                                                                                      |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>Caution: Never operate the sample draw pump unless the hose and probe assembly is attached.</b>                                                                                                                                                                                                                                                                       |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>! The sample probe handles contains replaceable filters designed to block noise and remove particulate contaminants. If the pump is operated without the probe assembly in place particulate contaminants may cause damage to the pump.</b>                                                                                                                           |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>Procedures for proper use of the motorized sample pump are contained in Chapter 2.</b>                                                                                                                                                                                                                                                                                |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | <b>Replacement of sample probe filters is discussed in Section 2.4.2.1.</b>                                                                                                                                                                                                                                                                                              |
|                                           |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         | As an additional safeguard, the pump also contains an internally housed particulate filter. If the                                                                                                                                                                                                                                                                       |

**Proper operation must be verified before the pump is put back into service.**

**Use the following procedure to verify pump performance:**

- (1) Attach the pump to your PhD Lite and turn the instrument on. Wait for the instrument to complete the self test sequence.

- (2) Verify that the pump is operating normally, an animated "X" icon in the upper left hand corner of the LCD display indicates that the pump is attached and in normal operation.

- (3) Verify that the pump passes the pump test. Remove the hose and probe assembly from the pump (if currently attached) then cover the pump inlet with a finger. If there are no leaks a message will be displayed indicating that the pump test passed.

- (4) Press "mode" to reset the pump and resume normal operation.

#### **5.4. Specific problems with motorized pump**

##### **5.4.1. Pump will not turn on**

###### **Possible causes:**

Pump is not properly attached to the instrument. Instrument is not turned on, instrument battery too low for pump operation.

###### **Solution(s):**

Make sure pump is properly attached to instrument, recharge or replace instrument battery/pack.

- (1) Can't resume normal operation after a "Low Flow" shut down

###### **Possible causes:**

Sample probe or internal pump filters need replacement, sample hose kinked, sample probe and probe assembly contains fluids.

###### **Solution(s):**

- (6) Press "mode" to reset the pump and resume normal operation.

**Note: The return authorization number must be clearly marked on the outside of the box.**

Prominently showing the return authorization number on the outside of the box ensures that it is immediately identified and logged into our system at the time it is received. Proper tracking helps avoid unnecessary delays in completion of service procedures.

**Note: It is usually best to return the instrument together with all accessories such as spare battery packs, chargers, and optional sample drawing pumps.**

To insure safe transport please use the original PhD Lite packing materials, or other packing materials which similarly protect the instrument and accessories.

**Thank you for choosing the PhD Lite, and thank you for choosing Biosystems.**